D 12 '21

The Heating and Ventilating Magazine

A MONTHLY JOURNAL OF ENGINEERING PROGRESS

Vol. XVIII. No. 12 — DECEMBER, 1921 — Published at Cooperstown, N. Y.

$2.00 a year 20 cents a copy — New York Office, 1123 Broadway

400,000,000 TONS

IRON ORE SHIPPED FROM MESABI RANGE

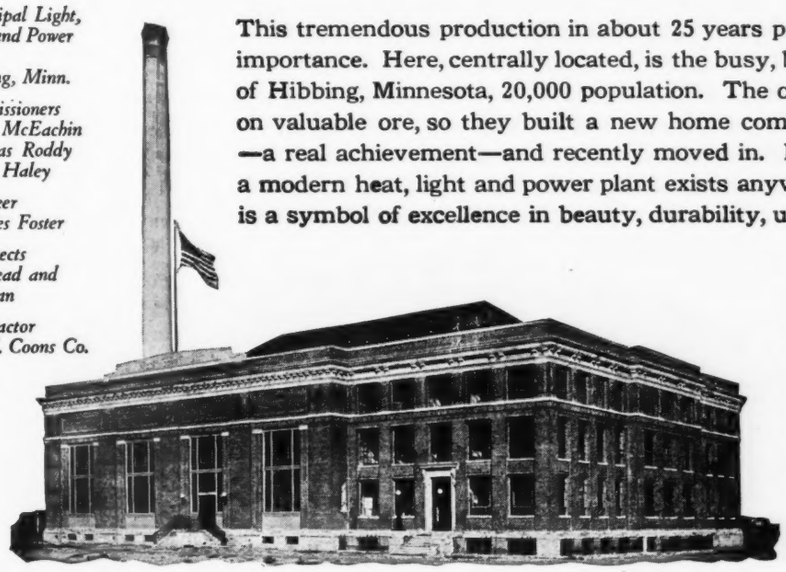
Municipal Light, Heat and Power Plant
Hibbing, Minn.

Commissioners
D. D. McEachin
Thomas Roddy
D. D. Haley

Engineer
Charles Foster

Architects
Holstead and Sullivan

Contractor
E. W. Coons Co.



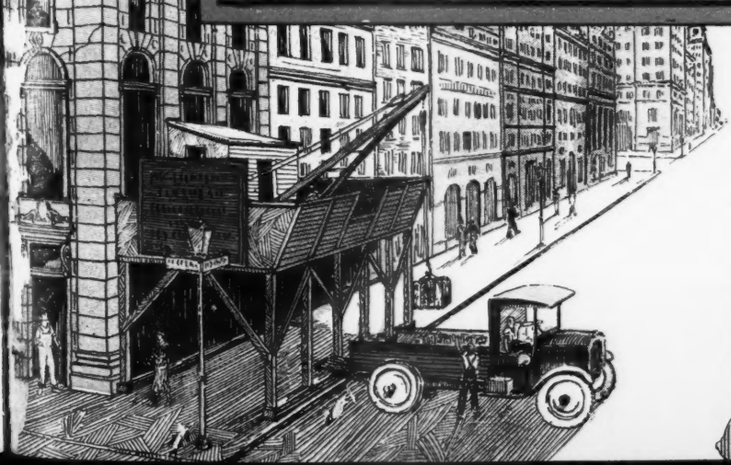
This tremendous production in about 25 years proves its worth and importance. Here, centrally located, is the busy, bustling new village of Hibbing, Minnesota, 20,000 population. The old village was built on valuable ore, so they built a new home complete in every way—a real achievement—and recently moved in. No finer example of a modern heat, light and power plant exists anywhere. Complete, it is a symbol of excellence in beauty, durability, utility and efficiency.

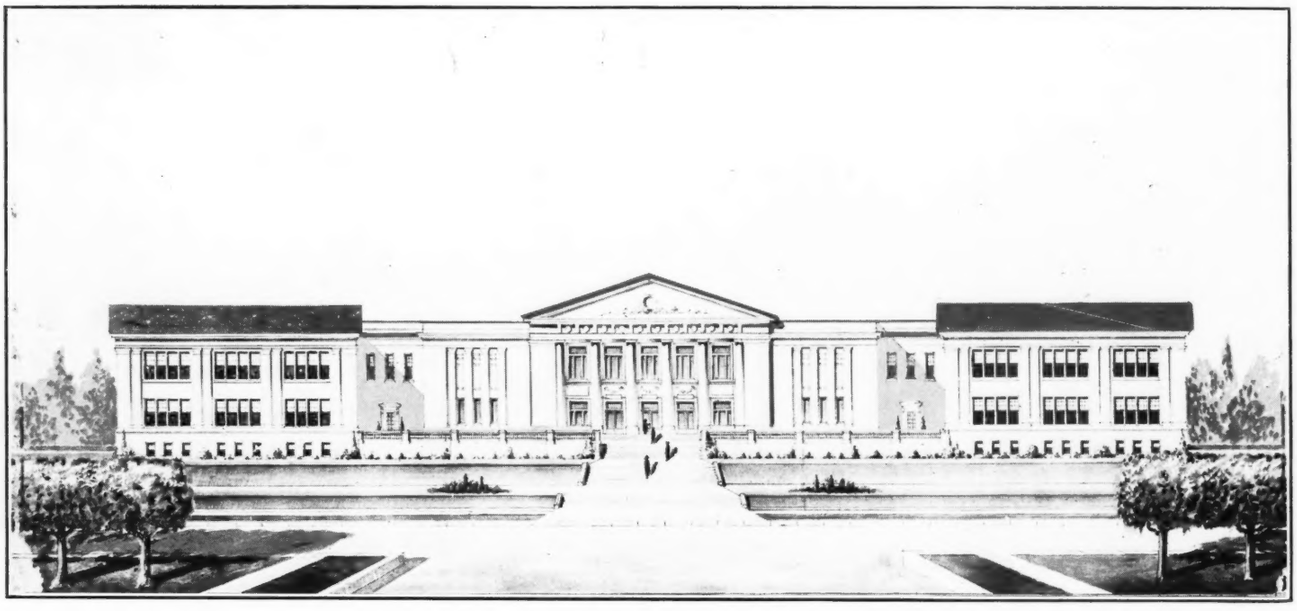
Our catalog containing a complete description of materials and blue prints showing typical installations and other valuable information regarding underground pipe construction will be gladly mailed upon request.

Agents in principal cities.

The same preference which was accorded RIC-WIL Method of insulating all of the underground pipes distributing heat from this modern plant is similarly exercised in numerous other plants, factories, colleges and public institutions.

THE RIC-WIL COMPANY, CLEVELAND





Architects—Jacobson & Jacobson
Owatonna, Minnesota

Htg & Vent. Contractor— P. J. Gallagher
Faribault, Minn.

CLARAGE
KALAMAZOO
MULTIBLADE FANS

THE Northwest is noted for its good schools. Towns boasting of hardly five thousand people usually enjoy educational facilities vastly superior to smaller towns back East. Owatonna, Minnesota, is no exception to the rule; for here, the citizens have built a high school rivaling any school of its size in the country. This is the Owatonna Junior and Senior High School, shown above.

When the Frank Tustison Company of Minneapolis, the Engineers, were selecting mechanical equipment for this school building, they chose Clarage-Kalamazoo Multiblade Fans for ventilating. These Engineers chose Clarage fans because Clarage-Kalamazoo Multiblade Fans are dependable. Not only are the fans capable of delivering large volumes of air at low speeds and with small consumption of power, but these Multiblade fans are so built and so constructed that they will give years of faithful service, without the necessity for any repairs.

Write for catalog No. 51.

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New York—149 Broadway
Philadelphia—320 Commercial Trust Bldg.
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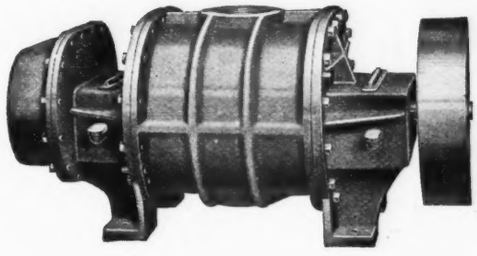
Cleveland—5716 Euclid Avenue
Chicago—111 W. Washington St.
Detroit—315 Murphy Building
Des Moines—602 Hubbell Bldg.
Los Angeles—706 Equitable Bldg.

Kalamazoo, Michigan

Victor Blowers
for
Oil-Burning Equipment



Efficient oil-burning plants require proper combustion of the fuel. This is more easily obtained by the use of positive pressure blowers with which the correct amount of air and pressure can be determined and then maintained.

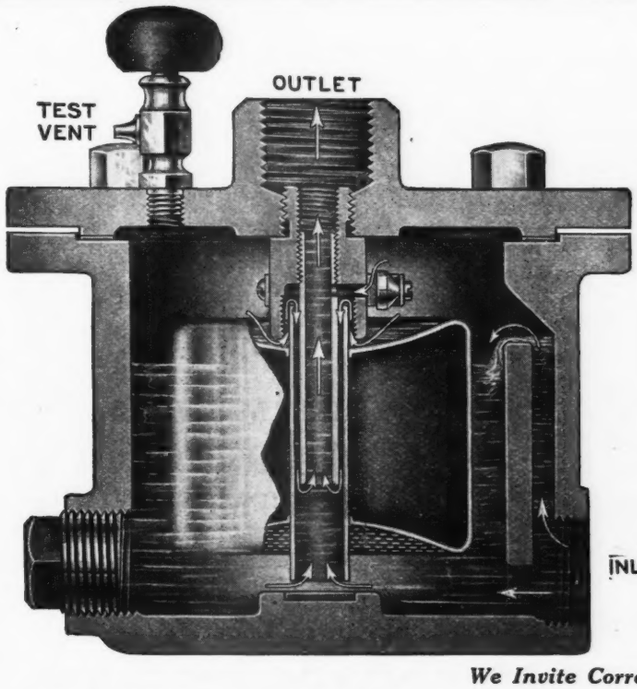
VICTOR BLOWERS. with their sturdy construction and economical operation, have successfully met the needs of this service. Once properly installed, they need no attention other than occasional oiling.

Bulletin 11H tells of the capacities of the different sizes.

The Connersville Blower Company

Connersville Indiana U.S.A.

Chicago, 1431 Monadnock Block New York, 114 Liberty Street



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DUPLEX WATER SEAL LOW PRESSURE
BLAST TRAP

FOR DIRECT OR INDIRECT COILS OR ANY LOCATION WHERE LARGE QUANTITIES OF WATER ARE TO BE DISCHARGED

Operates automatically either with or without mechanical suction on return line.

No complicated parts to stick or get out of order.

No small openings to clog up with sediment or scale.

Free passage of water—rapid and steady vent of air and passes no steam.

Combined action of flotation for water and all metal thermostatic vent for air together with relief of air through water seal makes the ideal trap for heavy service.

Adjusted and tested at factory and shipped ready for installation, to work automatically from below atmosphere on up to 25 pounds steam pressure.

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For Water and Steam

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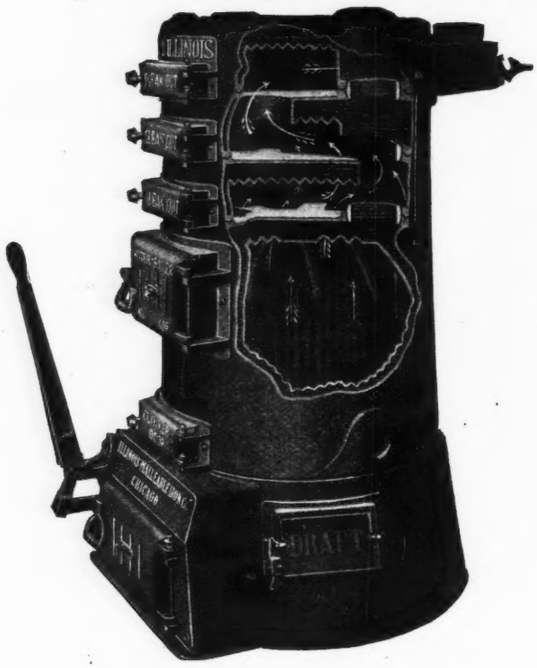

Imico Vacuum Heating System

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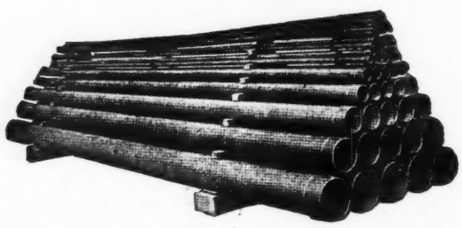

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Have a STEADY Water Line

Kewanee Boilers are built with *plenty* of steam space and so, the water stays in the boiler where it belongs and doesn't get into the mains and pipes and radiators.

That means *dryer* steam, and that's what is wanted.

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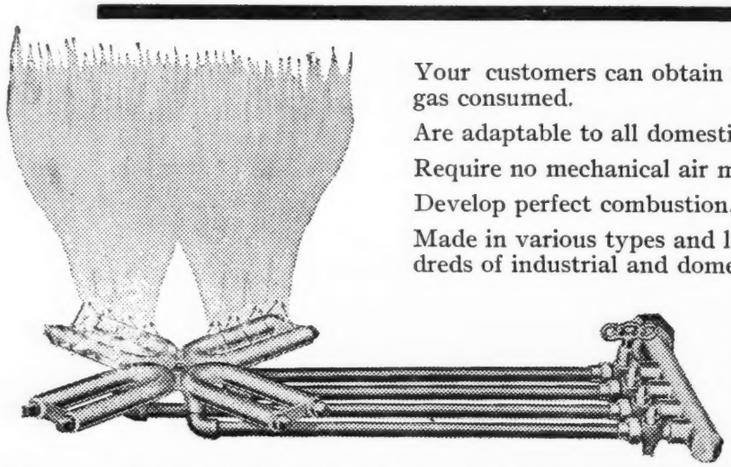
Manufacturers of Heating Appliances and Heating and Plumbing Contractors, Who Are Busy These Days

HAVE ADOPTED

Barber Patented Gas Burners



Your customers can obtain 25% to 40% more heat from the gas consumed.

Are adaptable to all domestic heating appliances.

Require no mechanical air mixers.

Develop perfect combustion.

Made in various types and layouts to specifically handle hundreds of industrial and domestic heating problems.

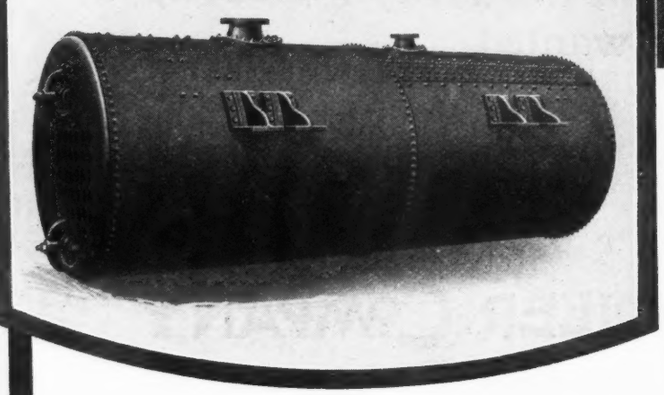
Can be quickly installed or removed from any appliance in a few moments if the gas pressure is entirely shut off.

Write Us for Our New Catalog Showing Complete Line and New Attractive Prices

The CLEVELAND GAS BURNER & APPLIANCE CO.

3702-04 Superior Avenue, Cleveland, Ohio

TITUSVILLE HORIZONTAL TUBULAR HEATING BOILERS



In addition to our line of high pressure ASME Horizontal Tubular Boilers, we have designed a complete line especially for low pressure heating. All the excellent features are retained, but when built entirely for heating they can be sold at a considerable saving.

Look into the TITUSVILLE HORIZONTAL TUBULAR HEATING BOILER before deciding on any other type.

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THE TITUSVILLE IRON WORKS COMPANY

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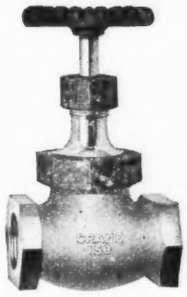

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No. 461 Iron Gate Valve

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made of brass, iron, ferrosteel, cast steel and forged steel, in all sizes, for all pressures, and all purposes, and are distributors through the trade, of pipe, heating and plumbing materials.

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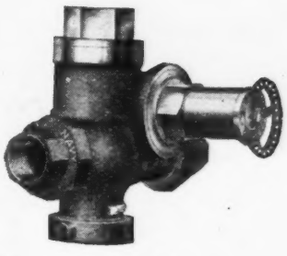

No. 962 Pressure Regulator

No. 20 Horizontal Brass Check Valve

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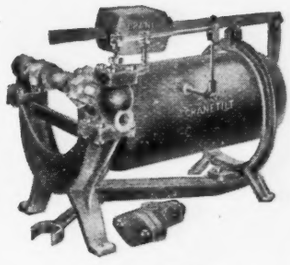

Non-Return Steam Trap

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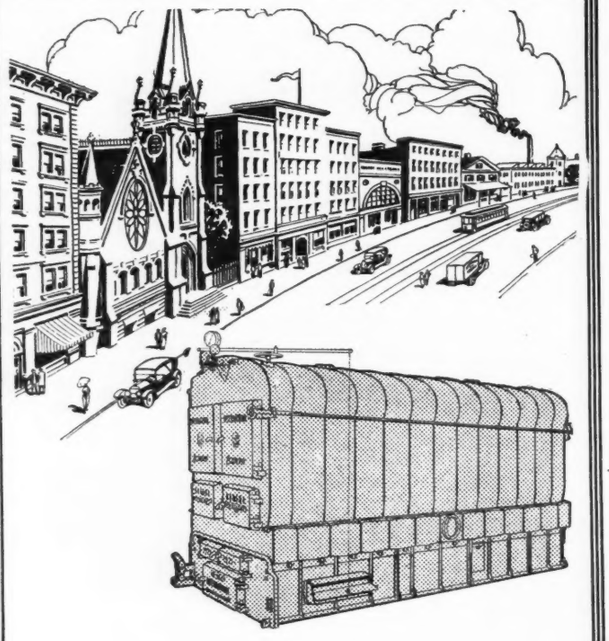

The *Big* Boiler in Your Town

Yes, it's the big jobs that attract attention. More than any others, they help to make your reputation as a steamfitter.

For this reason, it is prudent to select boilers for such jobs with great care.

THE 47" SERIES ECONOMY is preeminently the boiler for this work for many reasons. Just to state a couple of them briefly:

It is a single section boiler, easily mounted and so constructed that it is not necessary to build a separate header. See how that cuts your labor cost.

The evaporative power is higher than most boilers and the design insures economical use of the fuel.

Send for Bulletin 1436-H

INTERNATIONAL HEATER COMPANY
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SPENCER Magazine Feed HEATERS

Your Customers Will Appreciate a Heater that Requires so little Attention.

The Automatic Magazine Feed of the Spencer Heater makes an appeal to your customer which often results in the sale of not only the heater, but other units in the heating system.

The Spencer Magazine Feed assures a constant even heat. It requires filling only once in 12 to 24 hours.

Another feature of this Spencer Heater—It burns the cheaper, smaller sizes of coal, No. 1 Buckwheat. And it requires no more tons of this cheaper coal than other boilers require of larger size, more expensive coal.

Successfully burns No. 1 Buckwheat

We would like to help you where we can in your individual heating problems. So make use of any service which our representatives may be able to render. They are located in New York, Boston, Baltimore, Philadelphia, Buffalo, Detroit and Chicago.

Let us send a supply of Standard Heater Books —they're new.

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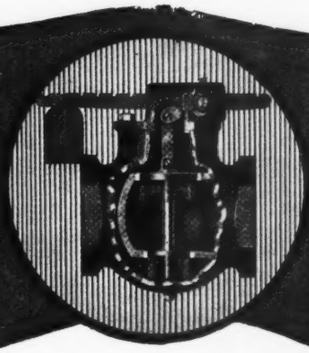


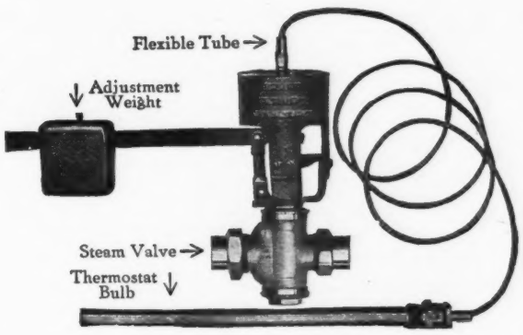
There's a Davis Back Pressure Valve for Heating Systems

THE Davis Back Pressure Valve maintains any desired back pressure on the exhaust line of a non-condensing engine for heating, drying or cooking of any kind. Dependable as gravity because controlled by weighted lever arm. Noiseless; will not bind or stick.

By giving dependable service throughout an unusually long life it exhibits traits characteristic of the big family of Davis Valve Specialties for heating systems. Get the 72-page catalog. Write the G. M. Davis Regulator Co., 436 Milwaukee Ave., Chicago.

DAVIS VALVE SPECIALTIES
STEAM SAVERS SINCE 1875

Controlled Heat—



Powers Regulator No. 11

The Powers No. 11 Automatic Thermostatic Regulator is an absolutely reliable and accurate regulator of the self-contained type, used for the control of liquid temperatures, and has a great variety of applications. Hot Water Tanks, Water Cooling Tanks, Feed Water Heaters, Size Boxes, Dyeing Machines, Washing Machines, etc., are all made automatic by its use.

For further details, prices, etc., ask for Bulletin 129.

A Powers Regulator is not only economical but accurate and dependable.

It saves labor, material and fuel, by shutting off superfluous heat—by removing the necessity of keeping an employee for heat regulation and by guaranteeing the correct temperature all the time.

Its material-saving properties are especially valuable wherever over-heating or under-heating is undesirable, as in the kiln, hot water tank, drying room, cooking vat, etc., etc.

The Powers Regulator is always on the job—never tardy— never resting—never too busy to turn the heat valve—never forgetting or shirking its duty. In short, while you can depend on employees to a certain extent the Powers Regulator can *always* be depended upon. It always does its duty—controlling the heat.

Built on scientific principles, it is entirely automatic. Once adjusted to a certain degree, exactly *that much* heat will be used.

Let the Powers Regulator solve your heat problem. Write us today. Avail yourself of our thirty years' research work in temperature control. This places you under no obligation.

THE POWERS REGULATOR CO.
Specialists in Automatic Heat Control

954 Architects Building, New York 2718 Greenview Ave., Chicago 565 Boston Wharf Bldg., Boston
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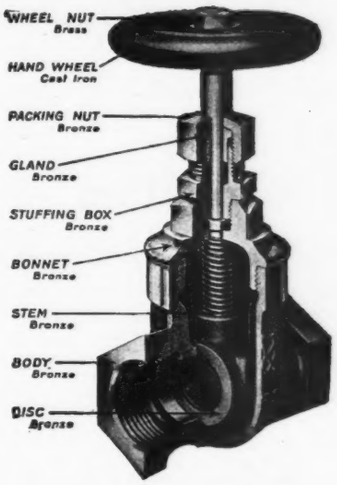
What is Your Valve Standard?



Most any valve will work well when new, but it takes a high grade product to stand up for a long period of years and to continue to give one hundred per cent efficient service. That's why engineers and contractors should safeguard the future interests of clients and customers by specifying KENNEDY Valves. In this way their specification carries with it the protection which the KENNEDY name and KENNEDY guarantee insure to valve users.

KENNEDY

For 42 years valve satisfaction has been the one object of the KENNEDY organization, and the improvements and developments which mark all valves bearing their trademark are sufficient proof of the success of their effort. Special features embodied in the design for the distinct purpose of giving long life include:

Pipe threads of generous length which prevent leakage.

Accurate guides for seat which prevent contact of disc with seat until the valve is ready to close.

Stem of special bronze with high tensile and torsional strength.

Gland in stuffing box which eliminates leaks and avoids frequent repacking.

Other special features of Kennedy Valves are given in our latest catalog. Send for copy and keep it handy.

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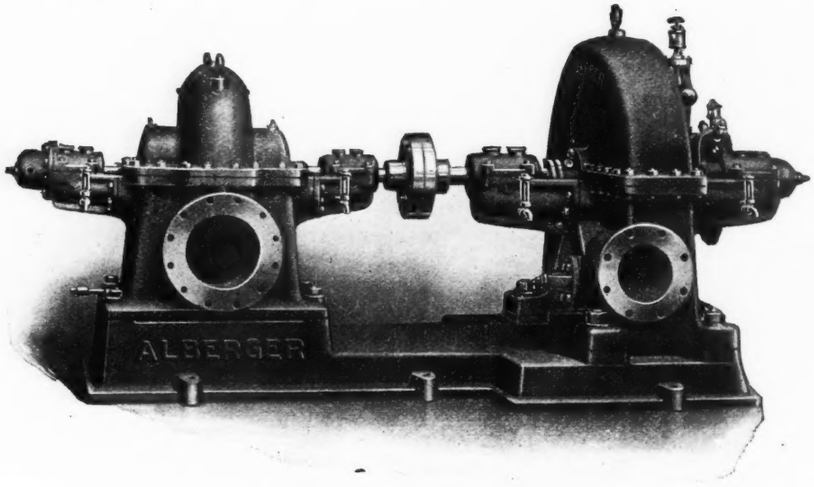
ALBERGER CENTRIFUGAL PUMPS

and Alberger-Curtis Non-Condensing Steam Turbines



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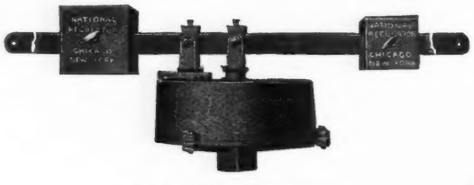
HOT WATER **LOW PRESSURE**

2" for Hot Water



7" for Low Pressure and Vapor

Made in 2", 4", 7" and 10" sizes

Metaphram Damper Regulators

For Low Pressure and Hot Water Boilers

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For Hot water Tanks, Ovens, Pots, Driers, Refrigeration and other industrial processes.

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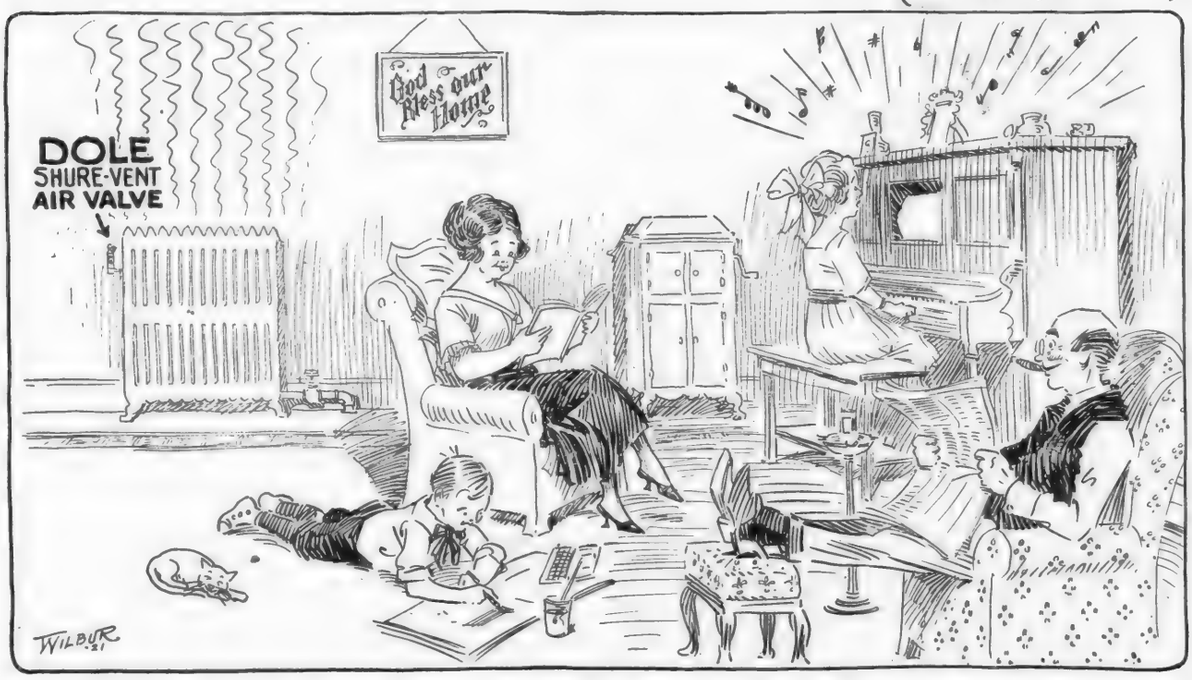
VAPOR

A-JACKS for HIGH PRESSURE

OH WHAT A DIFFERENCE A LITTLE VALVE MAKES !

Mc Swink was disgusted and loudly he swore,
Next winter they'd be in this cold flat, no more.
(and they moved)



Mc Swink proudly shouts as he turns to his wife,-
"**DOLE VALVES** on the radiators, this is the life!"
(and they never moved again)

BE CONVINCED

Send us a sample order and test them.

READ OUR GUARANTEE

The Dole Valve Co.

Makers of Dole Packless Radiator Valves
Dole Shure-Vent Air Valves

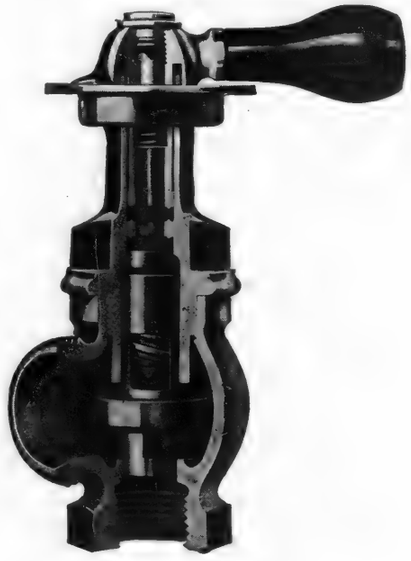
1923-1933 Carroll Ave. Chicago, Ill.

GUARANTEE

Should any Dole Shure-Vent Air Valve fail to vent properly during the life of the plant, a new valve will be furnished without question or charge.

There are plenty of valves on the market, but only one

LAVIGNE PACKLESS QUICK-OPENING STEAM RADIATOR VALVE



Sectional View
Lavigne
Graduated Packless Valve

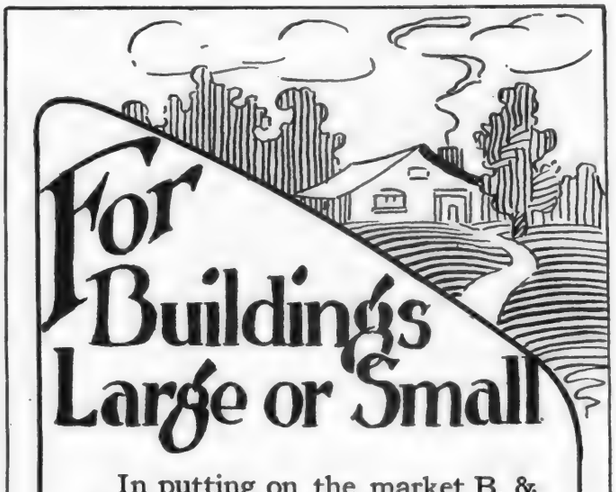
Made of the highest grade materials for rugged service.

Six sizes, many styles of handles

All good jobbers handle them

COMMONWEALTH BRASS CORPORATION

Detroit, Mich.



For Buildings Large or Small

In putting on the market B. & B. Line of Heating Specialties, it has been our aim to give the steam user the very best and latest in steam, water and air controlling and regulating valves made. Only the very highest grade of materials and only the very highest type of skilled labor are employed in their manufacture.

Each operation is watched with the greatest care, resulting in the highest possible perfection in Heating Specialties.

These specialties are constantly gaining prestige because of the universal satisfaction they give. Let us send our BULLETIN to you. It describes the B. & B. Line of Heating Specialties complete.

Send for Your Copy of Bulletin

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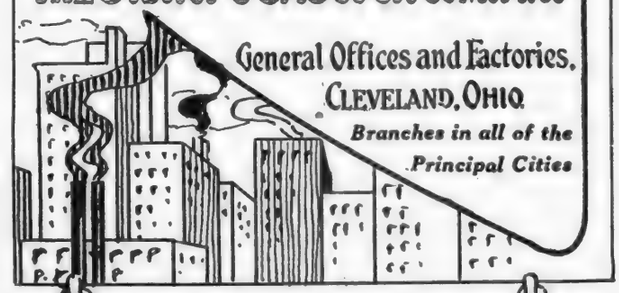
CLEVELAND, OHIO
Branches in all of the Principal Cities



The B & B Line

Greater Shorter Colleges, Rome, Georgia
A. W. Van Hoose, Pres. Rome Supply Co., Heating Contractors

This plant was installed in a little over thirty days from Moline Heat Construction Details. The most distant building is 1,000 feet from the boiler room. The plant is so simple that a single darky is the only attendant. Installed in 1910, and no call for repairs had yet been received in 1921.

WHY SADDLE REPAIR BILLS ON YOUR CLIENT?

It is no longer necessary!

It is more apparent every day that the discriminating client, he who has experience, desires a system of heating devoid of unnecessary apparatus. Hundreds of automatic devices, make operation uncertain and increase maintenance cost.

King George School, Moose Jaw, Can.
Moose Jaw Hdwe. Co., Htg. Contrs.
Moose Jaw, Canada.

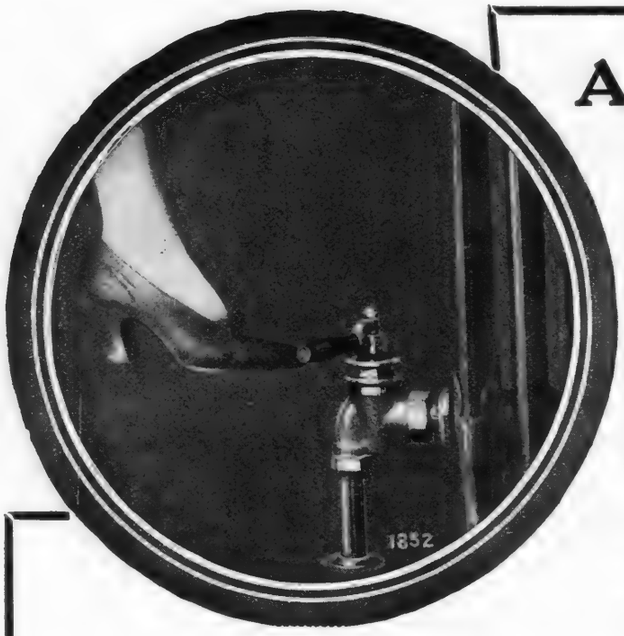
Moline Heat positively and noiselessly circulates steam through the most extensive plant at a pressure of a few ounces only. No automatic radiator traps required. Moline Heat equipment is simple and is applied where it will operate continuously—not at the return end of a radiator or coil where the dirt, oil and constantly accumulating sediment quickly make it inoperative.

Moline Heat does not furnish plans and specifications for competitive purposes but, when you order Moline Heat, complete Construction Details are furnished for your approval to make sure that Moline Heat equipment will be installed properly and under proper conditions. That is your insurance—your clients' insurance.

May we give you an estimate—will you send us a set of your plans of any kind of a building from residence to factory? If you haven't our catalogues, send for them. Write Dept. F.

MOLINE ILLINOIS

J. J. Moeb's Apartments, Washington, D. C.
C. L. Wenger, Htg. Contr.
460 radiators on this plant, with no automatic traps on them. Moline Heat does the work without any pumps to produce circulation.



No stooping—the slightest touch of the foot operates the valve

A Quarter Turn of the handle opens or closes the GORTON QUARTER-TURN VALVE

It is the easiest operating valve in the world, and users will regulate heat in a room by opening and closing the radiators, saving steam.

With the old time valve requiring five or six turns of the wheel to open or close the valve users open the windows to cool a room, an immense waste of steam.

Wasted steam is wasted coal.

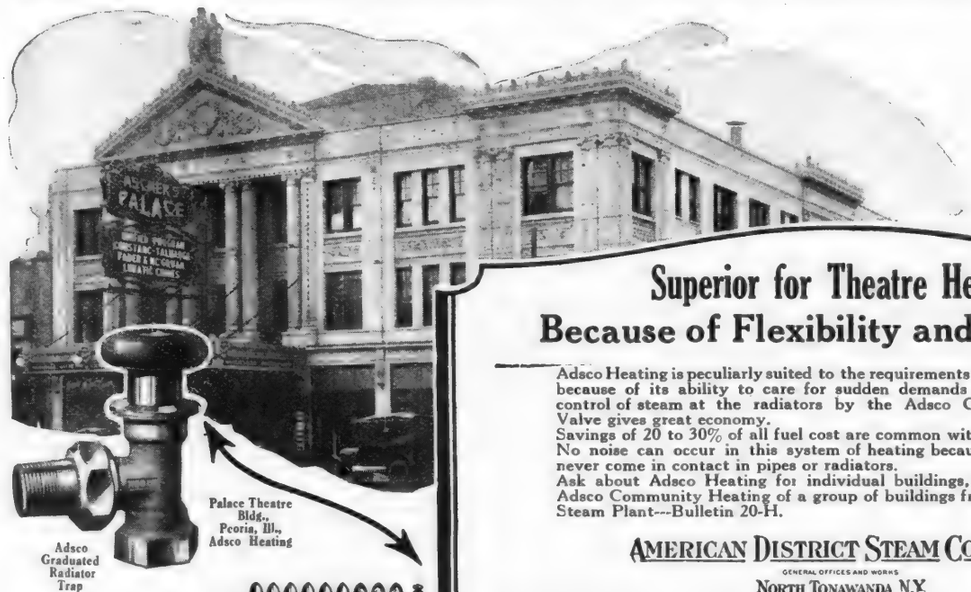
Equip your radiators with GORTON Valves and save money on your Coal Pile.

Write for Catalogue

Gorton & Lidgerwood Co.

Fisher Bldg., Chicago, Ill. **100 Liberty St., New York, N. Y.**

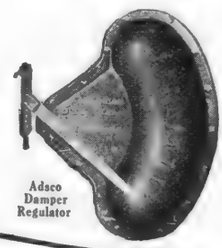
See Sweet's Architectural Catalogue, Page 1757, for Specifications



Adsco Graduated Radiator Trap

Palace Theatre Bldg., Peoria, Ill., Adsco Heating

Note steam at top of radiator, air in lower portion.



Adsco Damper Regulator

Superior for Theatre Heating Because of Flexibility and Economy

Adsco Heating is peculiarly suited to the requirements of theatre buildings because of its ability to care for sudden demands for heat. Positive control of steam at the radiators by the Adsco Graduated Radiator Valve gives great economy.

Savings of 20 to 30% of all fuel cost are common with Adsco Heating.

No noise can occur in this system of heating because steam and water never come in contact in pipes or radiators.

Ask about Adsco Heating for individual buildings, Bulletin 150-H; for Adsco Community Heating of a group of buildings from Central Station Steam Plant---Bulletin 20-H.

AMERICAN DISTRICT STEAM COMPANY

GENERAL OFFICES AND WORKS
NORTH TONAWANDA N.Y.

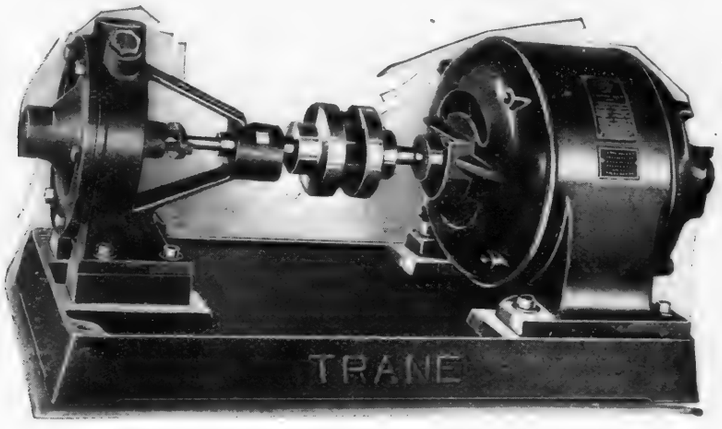
Agencies:

First National Bank Bldg. Chicago
1777 Woolworth Bldg. New York
Hoge Bldg. Seattle
2A Park St., Boston, Mass.
1404 Arrott Bldg. Pittsburg, Pa.

16221

ADSCO HEATING

Three New Listings



THE TRANE CIRCULATION PUMP, illustrated above, is offered in response to an insistent demand for a circulation unit of the same distinct design and remarkable performance characteristics as the Trane Condensation Pumps.

The Trane Pump is a remarkable development of the ordinary centrifugal type, performing more like a piston pump because of its ability to operate against high pressures, and because it requires a mimimum of power at low heads. Its field of usefulness is that of both the centrifugal and piston pump.

A new bulletin just issued, lists three sizes of Trane Circulation Pumps all made with an impeller less than five inches in diameter. This one moving part, because of the Trane patented design, pumps much higher pressures that can be obtained with a centrifugal two or three stage pump with the same diameter impeller.

Ask for Bulletins

Bulletin No. 2—Trane Condensation Pumps
Bulletin No. 3—Trane Circulation Pumps

The Trane Company, 206 Cameron Ave., LaCrosse, Wis.

Chicago New York Philadelphia Washington, D. C. Cleveland Buffalo Salt Lake City Portland, Ore.

TRANE PUMPS

Webster

Systems of Steam Heating

In all extremes of building types from private residences to factories, from office buildings to churches, and from country school-houses to universities, Webster Steam Heating Systems and appliances are providing comfortable and economical warmth in every part of the country.

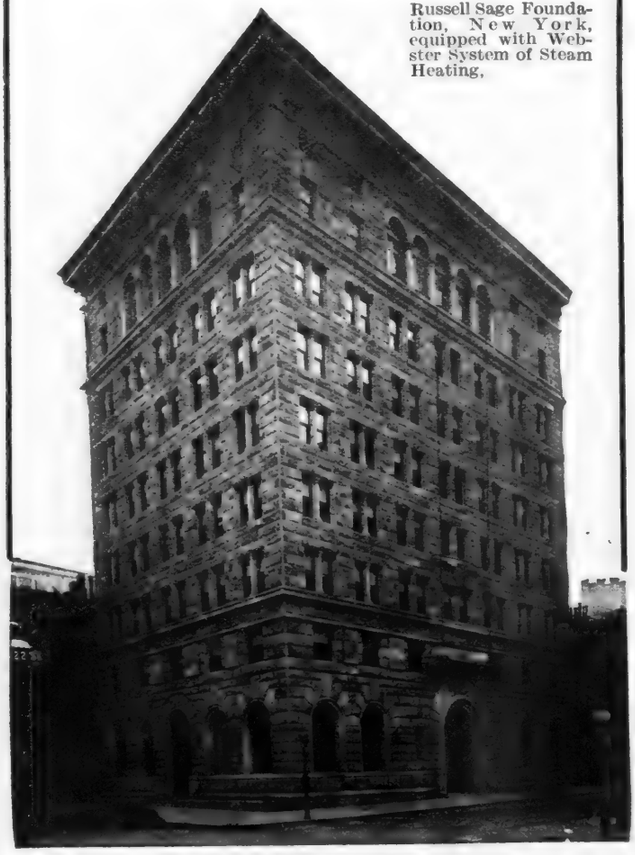
The engineer who uses Webster equipment is assured of permanent satisfaction by the Webster experience of 33 years, by the well-known mechanical excellence of Webster apparatus, and by the Webster free consultation service offered through 31 conveniently located branch offices and service stations.

We have made over 17,000 successful heating system installations, a great many of which were changed over from old heating systems. In such cases, the saving to be made can be definitely guaranteed and often realizes a return of 25% or more on the investment.

Write for Bulletins

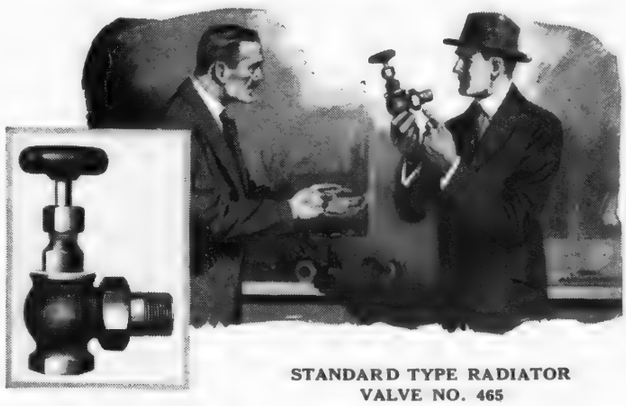
WARREN WEBSTER & COMPANY
Camden N. J.

BRANCHES IN 31 CITIES 96



Russell Sage Foundation, New York, equipped with Webster System of Steam Heating.

The largest plant in the world devoted to the manufacture of THERMOSTATIC INSTRUMENTS



STANDARD TYPE RADIATOR VALVE NO. 465

"But why are Fulton Valves Better?"

"I thought all packed type radiator valves were made in about the same way," said the customer.

"Most of them are," replied the steam fitter. "I will show you the difference."

"This 1 inch Fulton Valve weighs one pound more than any other, and the weight is put where it is needed most. The bonnet of the Fulton Valve weighs twice as much as this other one. Just look at the strength of the Fulton union nut.

"Another thing, the stem is made of extruded brass rod instead of being cast brass. It cannot have blow-holes in it and if bent, can be straightened, and cannot be twisted off in service.

"The packing nut which holds the packing is extra heavy, with broad faces to easily engage the wrench so the valve can be packed tight.

"This Fulton bonnet has more threads to engage the body of the valve, and it is milled hexagon instead of square which makes it—"

"There seems to be no comparison at all," said the customer, "but at a higher price—"

"The price is not higher," interrupted the steam fitter, "and then, too, this is the same body and union nut that they use on their Sylphon Leakless Valve, and if, at any time, you want to do away with the necessity of ever re-packing these valves, you can substitute a new top at a very slight expense."

"Fine" said the customer. "Of course I will take Fultons."

Write for interesting information about our Standand Type Radiators Valve No. 465.

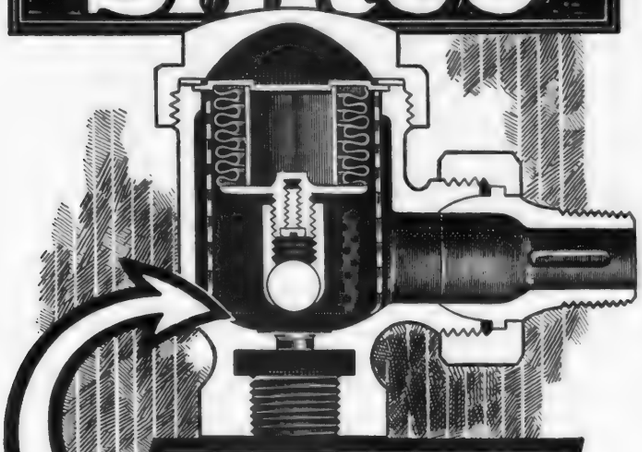
THE FULTON COMPANY
KNOXVILLE, TENN.

New York	Detroit	Chicago
Hudson Terminal Bldg.	Book Bldg.	Wrigley Bldg.
50 Church St.	1247 Washington Blvd.	400 N. Michigan Ave.

Sylphon TRADE MARK

Fulton Standard Type Radiator Valves are marked with the word "Sylphon" which is our registered trade mark. We wish to state clearly however that they are packed valves and do not contain the famous Sylphon bellows.

Radiator Trap SARCO



This wide opening permits *Free Discharge*

A full quarter-inch clearance between the valve seat and the ball valve. That's why the Radiator Trap Sarco discharges so freely. It provides an *ample vent* for the escape of the condensation.

If a radiator trap doesn't discharge freely it falls down in the performance of the very thing for which it was made. You'll find a vast difference between the performance of an ordinary trap and the Sarco in this respect. And in other respects, as well.

Just as it *opens freely*, so the diameter of the thermostatic element, together with the character of the volatile fluid used, insures *maximum closing pressure.*

This perfect functioning is earning for the Sarco, among engineers and heating experts, a reputation for reliable operation that should make it *your* choice for the trapping of steam vacuum or vapor heating systems.

One more point in favor of the Sarco. Due to the *spiral* instead of *annular* corrugations of the thermostatic element, the wear is so distributed as to become negligible. The life of this part of the Sarco is greater by many times than the life of the corresponding part in other traps.

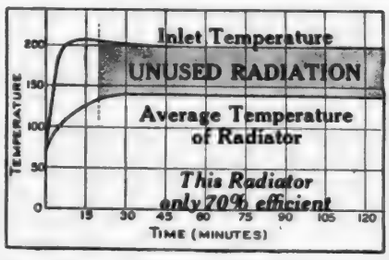
Made in ½" and ¾" sizes, with nickel finished brass bodies; in four types, angle, straightaway, and right and left offset.

A Postcard brings our illustrated Booklet P-102

SARCO CO., Inc.

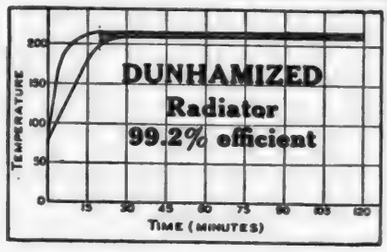
23 Broadway New York City

Buffalo Chicago Cleveland Detroit Philadelphia



Not Dunhamized

Dunhamized



Unused Radiation is Costly

Keep it down with Dunham Traps

IN the above charts, the area of "Unused Radiation" has been plotted from laboratory data. We are constantly making such tests. They tell us accurately how the Dunham Radiator Trap compares with other traps.

Your interest is ours—and that is the reduction of the "Unused Radiation" area. When the two temperature curves approach the point of coincidence, then you will have done your full duty to your client—and we to you. Then rooms will warm up as you figured they would; noise and dissatisfaction will disappear; more heating comfort per ton of coal will become a reality.

It will be of mutual interest for us to discuss radiator efficiency.

Full details of the Dunham Trap, and other Dunham Specialties, are given in the 16th edition of Sweet's Index, pages 1498 to 1501.

The DUNHAM HEATING SERVICE
REG. TRADE-MARK

C. A. DUNHAM CO., 230 East Ohio St., CHICAGO

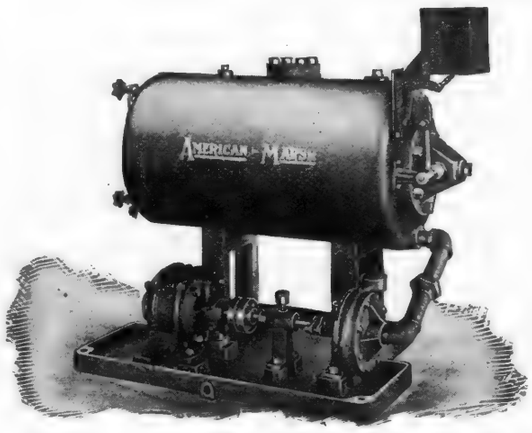
Factories: **Marshalltown, Iowa, Toronto, Canada**

52 Branch and Local Sales Offices in the United States and Canada.

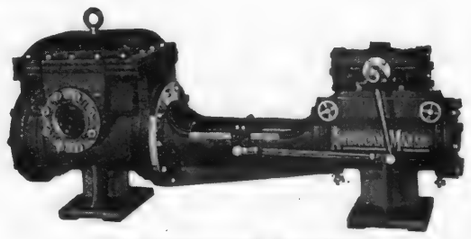
Foreign Sales Offices in London and Paris

American-Marsh Pumps

for Heating Systems



For use in returning the condensation to the boiler on heating systems where the steam pressure is too low to operate a steam pump. Water is returned to the boiler in its hottest state. Equipped with an automatic float valve which is positive and reliable.



The Recognized Standard

American-Marsh Vacuum Pumps have been recommended and specified by a majority of the leading heating engineers and Contractors for over twenty years.

Made with only best of material and workmanship. Highest efficiency guaranteed.

Equipped with an improved steam valve which is especially adapted for vacuum service. American-Marsh Pumps are positive in action, possess a perfect governing element and will not hang up under all the varying conditions.

Ask for Bulletins Nos. 24 and 27

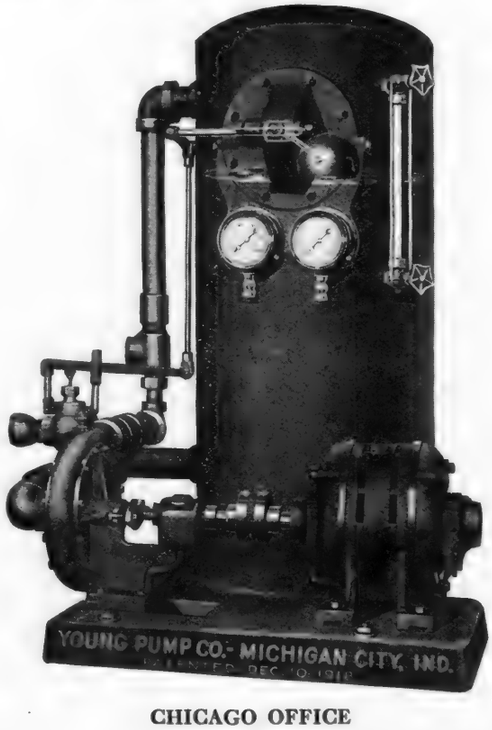
AMERICAN STEAM PUMP CO.
Battle Creek, Mich.

Our slogan: Simplex not Duplex. "To be simple is to be great"

Young Centrifugal Vacuum and Boiler Feed Outfits

Consists of a centrifugal pump with motor direct connected, tank, exhauster and balanced by-pass valve. The pump, motor and tank are mounted on a substantial cast iron base and the outfit completely assembled as shown in the cut, so that as received on the job it is only necessary to make pipe connections to the system and boiler, wiring connections to the motor, when it is ready for operation.

It is the simplest outfit made. There are no valves, springs or other parts that require adjustment, wear out or cause repair expense; not a feature more complicated or liable to cause trouble than the motor.



Made in six sizes to handle 4,000, 8,000, 16,000, 26,000, 40,000 or 65,000 sq. ft. of radiation; for continuous operation or automatic control, to meet any condition or pressure.

Complete information and prices upon application.

Write for descriptive pamphlet.

CHICAGO OFFICE

327 S. La Salle St. **Phone Harrison 5920**

OZONE PURE AIRIFIER

The installation of the "Ozone Pure Airifier" in connection with Fan systems of heating and ventilation in schools, theaters, banks and manufacturing plants, permits of re-circulation of a large percentage of the total air volume handled.

ADVANTAGES

Saving in Cost of Operation

1.—Reduction of 25 to 50% in coal consumption.

2.—Reduction in Steam Consumption.

Saving in initial Cost of Mechanical Equipment.

1.—Tempering coils may be omitted.

2.—Boiler capacity may be reduced.

3.—Sizes of steam and return pipes, valves, fittings and pumps may be reduced.

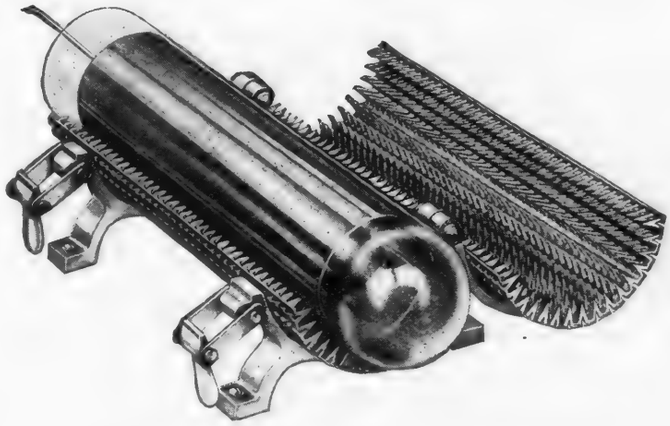
RESULTS

Pure air in rooms, free from organic odors and impurities.

The power consumed by the apparatus is extremely small, being only about 120 watts maximum for a 25,000 cu. ft. (per minute) machine when operating on alternating current. Based on an energy cost of 10c per kw. hr., this would give a cost of 12c per 10-hour day.

We will be pleased to send literature on this subject to anyone interested,

Ozone Pure Airifier Co.
1403 W. Jackson Blvd.
CHICAGO, ILL.



One complete unit capable of properly ozonizing 1000 cu. ft. of air per minute. The unit is shown open to illustrate simplicity of construction and ease of cleaning.

ALLEN AIR-TURBINE VENTILATOR

Standard of Ventilating Efficiency

Wherever ventilation is desired—in factories, foundries, stores, schools, hotels, churches, theatres, residences, kitchens, bakeries, tanneries, barns, stables, garages, chimneys, air shafts, or wherever air circulation is required, Allen Air-Turbines *have proven the best, cheapest and most efficient* ventilating system known.

Many of America's largest architects, engineers and industrial concerns have adopted and endorse Allen Air-Turbine Ventilators.

Our air displacement is measurable and the figures given are guaranteed to be correct.

Diameter of Pipe	Air Displacement Cu. Ft. per Hour	
	Wind Velocity 4 Miles per Hour	Wind Velocity 8 Miles per Hour
8 Inches	17,300	21,600
10 "	26,500	32,500
12 "	38,600	46,200
15 "	54,000	69,000
18 "	85,200	102,100
20 "	105,100	125,600
24 "	149,000	185,000
30 "	225,000	272,000
48 "	360,000	473,000

Patented

CARRIES OFF
GASES
MOISTURE
STEAM
SMOKE
VAPOR
FOUL AIR
ODORS
HEAT
FUMES
DUST
DAMPNESS

Write for Detailed Literature

ALLEN AIR-TURBINE VENTILATOR CO.
DETROIT Eighth and Porter Sts. **MICHIGAN**

The Mouat Vapor Heating System

To secure a satisfied client you must specify or install a heating system which is simple, economical, efficient and of easy control.

All these qualities are to be found in THE MOUAT VAPOR HEATING SYSTEM.

Send for Circular on the Mouat System.

The Mouat-Squires Company, Cleveland, O.

A leak in a new job is a mighty bad advertisement for the man who puts that job in.

The use of one can of SHUR-TITE Boiler Repair Cement in every heating job will save you expense and trouble of fixing small leaks that invariably occur.

And, SHUR-TITE is easy to use.

Simply pour it in the system before filling for test and the leaks will stop.

Your Jobber has SHUR-TITE or he will get it for you.

Desirable territory open for live representatives. Write us at once if interested.

THE DOUGLASS HUMIDIFIER

STANDARD TYPE
Made in three sizes for direct connection to steam piping

Is attached directly to the steam heating system

Discharges dry steam noiselessly

Gives satisfactory results in any type of building equipped with steam

Inexpensive to install

Will not get out of order

No attention required

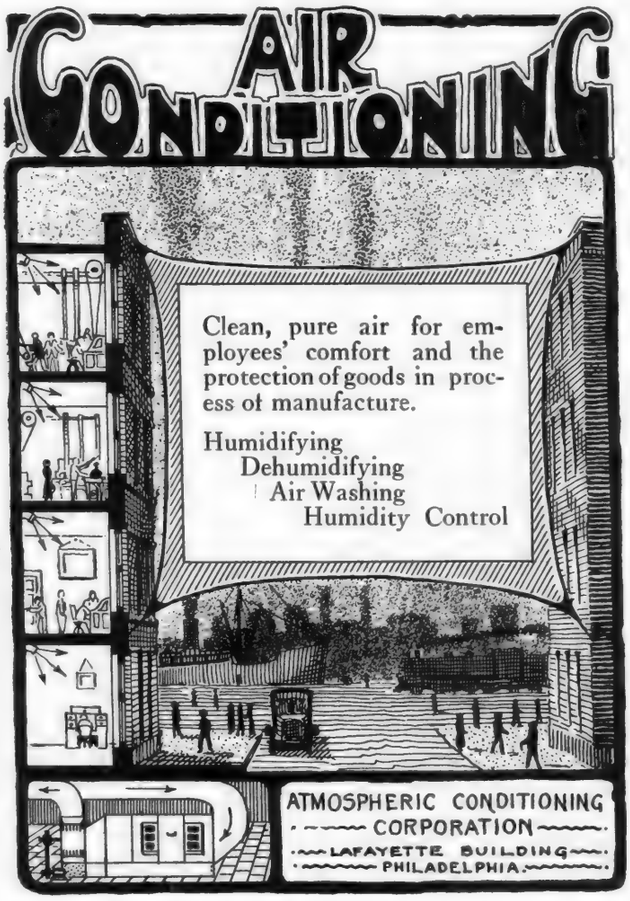
No maintenance expense

Made in various sizes and types to suit all conditions and requirements

Illustrated catalogue sent on request

THOMAS J. DOUGLASS & CO.
441 N. Dearborn St.
Chicago, Ill.

RADIATOR TYPE
Is attached to steam radiator in place of the air valve.
Made in one size only.



More in Your Favor

—with

Mel-Rock Air Washers

MEL-ROCK Air Washers possess many exclusive points of advantage, which are of high value. For instance:

EACH CAPACITY is made in from four to seven different proportions, so that any space and head-room may be accommodated.

MEL-ROCK Eliminator Systems are made in batteries, riveted at the factory. This saves you considerable time and money in setting up.

MEL-ROCK Mist Nozzles discharge a greater volume of mist, at low pressure.

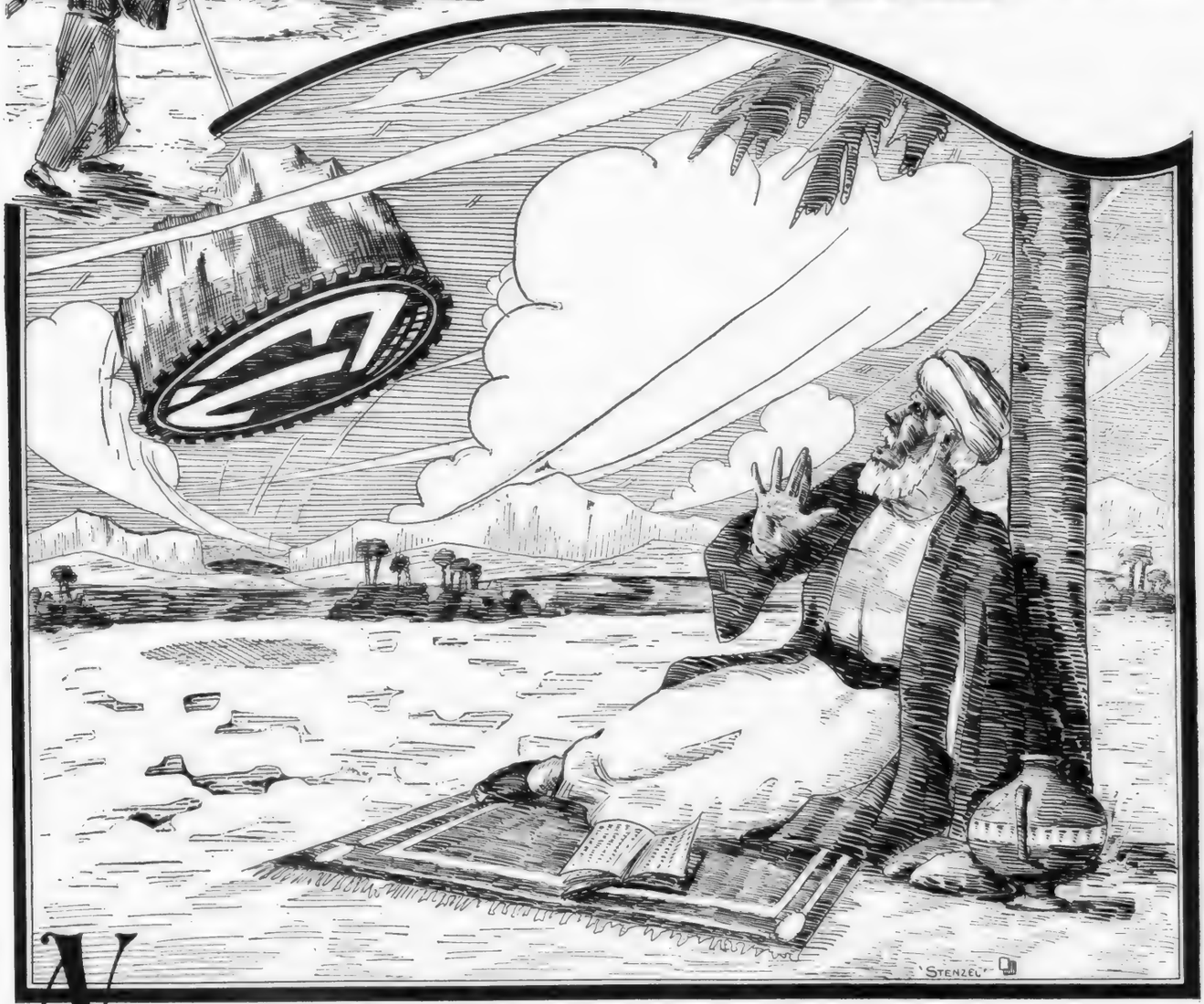
MEL-ROCK stands .or the very highest development in air-washing efficiency and economy.

Send for descriptive catalog.

TO AGENTS—There is still some good, exclusive territory open. Write for particulars.

MELLISH-HAYWARD COMPANY
213 West Austin
CHICAGO

When the mountain not having come to Mohammed Mohammed went to the mountain



Now the mountain is brought to Mohammed

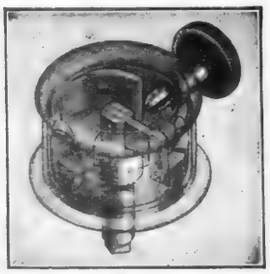
There was a time when manufacturers located their plants wherever suitable climatic conditions could be found. Like Mohammed, they went to the mountain.

Now—mountains are still immovable, but W. L. Fleisher's Engineers are delivering thru Sturtevant equipment a uniform climate of just the right temperature and humidity 365 days in the year to manufacturers in every part of the world. How? Write.

B. F. STURTEVANT COMPANY, HYDE PARK, BOSTON

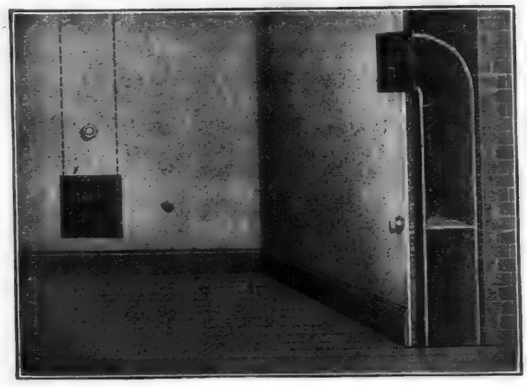
Sturtevant
PUTS AIR TO WORK

Absolutely Prevents Tampering by Unauthorized Persons



The Perfect Damper Regulator and Indicator

positively regulates the supply of hot or tempered air in heating and venting systems.



May be placed on the wall of a room where the ventilating ducts are concealed within the wall and the damper connected to it by an extension of the square damper rod. Especially useful in school rooms to control the inflow of tempered air and exhaust of vitiated air.

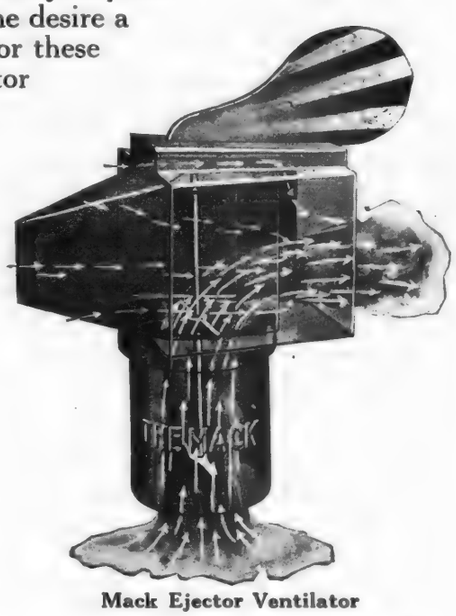
Send for new circular fully illustrating and describing this device.

The Sixth City Sheet Metal Works Co.
1830 St. Clair Ave., Cleveland, O.

"Exhaust Without Cost"

Air-o-matic Stationary Ventilator

People differ as to what they require of a ventilator. Some desire a stationary ventilator and for these the **AIR-O-MATIC** ventilator will exclude down-drafts, snow, and rain, while it is effectively exhausting all foul air. Other people require mechanical ventilation and for these there is no device superior to the **MACK** ventilator for heavy duty under conditions of light wind.



Mack Ejector Ventilator

Both of these ventilators are of sturdy, durable construction and both eliminate operating expense

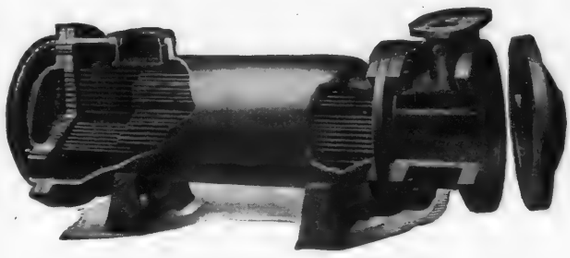
Write us for full details

THE STARK SHEET METAL WORKS CO., 418 Second St., S. E., Canton, Ohio

Hot Water Service Heaters

Backed by 50 Years' Heat Transfer Experience

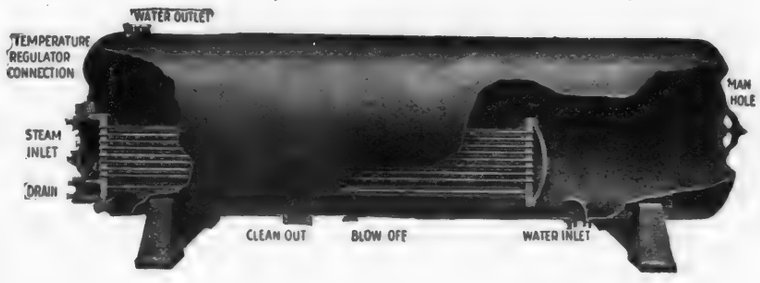
G-R Instantaneous Heater



The water passes through straight brass tubes and is heated by either live or exhaust steam in the cast iron shell.

Floating head permits expansion or contraction of tubes without strain on tube joints.

Russell Storage Heater



Constructed in accordance with modern engineering progress. Shell of boiler steel, riveted or welded.

Heating element straight, seamless drawn brass tubes.

Entire tube bundle removable. Floating head eliminates expansion and contraction strains.

Send for Bulletins

THE GRISCOM-RUSSELL CO.

2155 West Street Building, New York

Philadelphia	Pittsburgh	Chicago	New Orleans	San Francisco
Boston	Cleveland	Minneapolis	Houston	Seattle
Hartford	Toledo	Milwaukee	Fort Worth	Los Angeles
Springfield	Detroit	St. Louis	Charlotte	Kansas City
	Denver	Salt Lake City		

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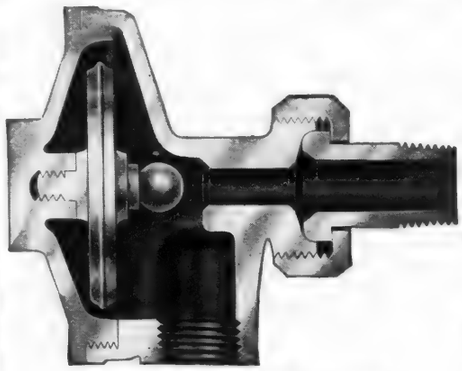

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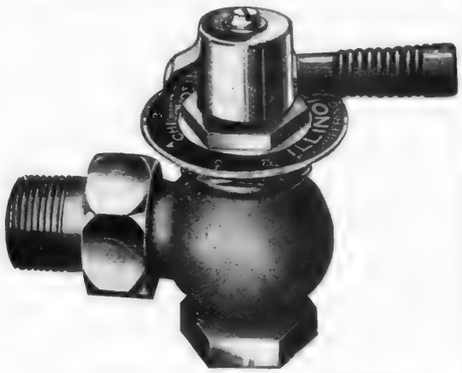

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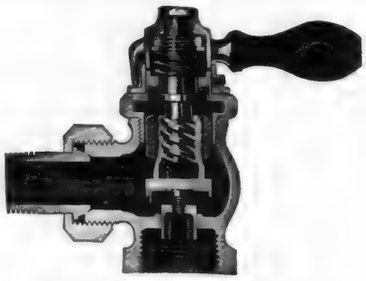

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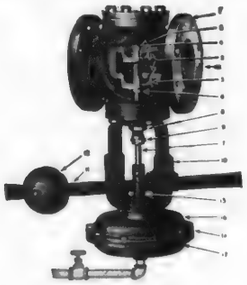

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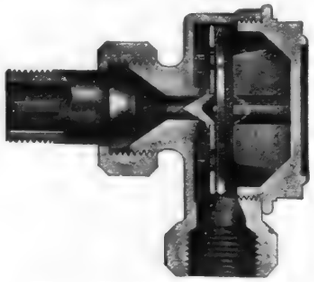

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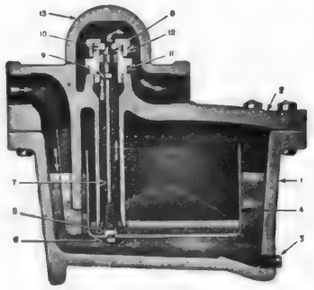

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The Heating and Ventilating Magazine

VOL. XVIII. NO. 12

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DECEMBER, 1921

WHAT ABOUT OZONE?

Details of the Recently-Completed Chicago Tests to Determine the Status of Ozone for Ventilation

BY E. VERNON HILL AND JOHN J. AEBERLY, M. E.
Of the Chicago Department of Health

II.

REPORTS OF EXPERIMENTS

IN REPORTING on the results of the experimental work it appears desirable to take up the discussion under the various headings set forth in the program, rather than to describe the successive experiments as they were made. The writers are of the opinion that this method will be of more interest to the reader than a technical description of the tests in the series in which they were performed.

Each experiment was undertaken with some definite purpose and most of the experiments comprise several separate tests. The experiments will be referred to by their serial numbers, and also the test under each experiment; for example, experiment 8, test No. 2 refers to experiment 8 which was conducted to determine the drop in ozone concentration due to the passing of ozonized air through clean, galvanized sheet-iron ducts. Test No. 2 is the second test in experiment 8. A complete tabulation of experiments and tests will be given at the end of the article.

OZONE CONCENTRATION PERCEPTIBLE TO THE SENSES

Experiment No. 10:

This experiment was conducted to determine the lowest concentration of ozone that could be detected by the sense of smell. The ozone machine was started with twenty standard units in the machine. At the outlet of the ozone machine a 3-in. galvanized-iron duct 40 ft. in length was attached. This duct was carried from the ozone machine out through the door of the cabinet to a point within 3 ft. of the open window. This was done for the purpose of allowing the observer to stand at the open window and inhale the outside air for a considerable period of time before testing by the sense of smell the air coming from the ozone machine. As ozone can be detected by the sense of smell in concentrations very much lower than can be detected by the chemical method it was necessary in this experiment to start with a low concentration that could be measured by our chemical method and to reduce this by a process of mechanical dilution by reducing the number of units and by increasing the air flow through the machine.

Test No. 1:

This test was conducted with a voltage of 3,440. This low voltage was used to obtain a low concentration from the machine at the beginning of the experiment. Tests were then made at the outlet of the duct to determine the concentration of ozone. This was found to be 1.33 parts per million. A careful examination of all the units in the cabinet showed each to be operating uniformly.

Test No. 2:

A second test was made of ozone concentration at the outlet of the duct, which did not vary perceptibly from the original. The door at the outlet of the duct, with a concentration of 1.33 parts per million, was very strong and if inhaled for any considerable length of time irritated the respiratory mucous membranes.

Test No. 3:

In this test one-half of the units were removed from the cabinet. The same amount of air passing through the duct gave necessarily in this test one-half the concentration of ozone. The odor was plainly evident, as tested by four different observers, Messrs. Stahl, Durkin, Aeberly and Hill.

Test No. 4:

One-half of the remaining units were removed, leaving five in the cabinet. This gave a concentration of 0.33 parts per million. The odor was still unquestionably present.

Test No. 5:

In this test three of the remaining units were removed, leaving two in the cabinet, giving a concentration of 0.133 parts per million. The odor could still be clearly detected.

Test No. 6:

One of the two remaining units was removed from the cabinet, giving 1/20 of the original concentration, or 0.066 parts per million. The odor in this test was still discernible to all observers. This was the lowest limit of concentration obtainable with the machine by reducing the number of units.

From this point we increased the volume of air passing through the machine until the calculated concentration was 0.01+.

Test No. 7:

At this point it was necessary for the observers to stand for considerable periods of time at an open window before being sure that they could detect the ozone odor at the outlet duct. It was a question in the mind of Dr. Hill whether he could detect the odor with this concentration.

At the beginning of each test anemometer readings were taken at the outlet of the duct to determine the air volume and to be sure that it remained constant. As the units in the cabinet were connected in parallel the removal of the various units in succession resulted in a corresponding proportional drop in power consumption, the voltage remaining constant. Between each test the fan was operated with the ozone machine shut off until there was no odor of ozone from the duct itself.

Experiment No. 3:

This experiment was conducted to familiarize ourselves with the operation of the equipment and for practice in making determinations by the cadmium iodide method. The ozone machine was operated at voltages varying from 4,180 to 7,300. The ozone concentration in the cabinet varied from less than 1 to as high as 3 parts per million.

Test No. 1:

This test gave an ozone concentration of 8.1 parts per million at the outlet of the machine, which gave a concentration in the cabinet of from 1 to 3 parts per million, depending upon the time the machine was in operation. With 3 parts per million smarting of the eyes and nose was noted by Mr. Aeberly and, finally, a coughing fit occurred which compelled him to leave the cabinet after a stay of ten minutes.

Test No. 2:

With a voltage of 7,300, a concentration at the outlet of the machine of 12.8 and a concentration in the cabinet of from 3 to 6 parts per million was obtained. Dr. Hill took the tests in the cabinet, remaining for a period of 12 minutes. The operation of the pump in taking the samples caused frequent coughing, which continued for some time after leaving the cabinet. No ill effects were experienced by Dr. Hill after the immediate effects had disappeared. Mr. Aeberly complained of hoarseness and general irritation of the respiratory passages for several days following the experiment.

Test No. 3:

This was conducted with a voltage of 4,180, with an ozone concentration leaving the machine of 2.6, giving a maximum concentration in the cabinet of 0.8 parts per million after 45 minutes. Dr. Hill took the samples in this test and complained of no ill effects except a slight smarting of the eyes after being in the cabinet practically all the time during the test, a period of 30 minutes.

From these tests and from a survey of the literature the following table is compiled, which gives the effect of various concentrations as far as we have been able to determine them up to the present time:

EFFECTS OF VARIOUS CONCENTRATION OF OZONE AS GIVEN BY DIFFERENT AUTHORITIES.

Ozone concentration parts per million		
0.01	Barely distinguishable to keen sense of smell	(Hill and Aeberly)
0.02	Concentration found in nature at an altitude of 4,000 ft.	(Thierry)
0.04	Found in nature at an altitude of 12,000 ft.	(Thierry)
0.06	Clearly distinguishable to sense of smell	(Hill and Aeberly)
0.48	Cheese cloth impregnated with tobacco odor deodorized in 9 minutes, cheviot in 29 minutes, satin in 18 minutes and duct in 6 minutes.	(Hill and Aeberly)
1.00	Irritating to mucous membrane on long exposure.	(Hill and Aeberly)
2.3	Materially reduces odor of casein	(Franklin)
3.00	Irritating to mucous membrane on continuous exposure for two hours.	(Hill and Aeberly)
4.00	Hastens the rate of disappearance of odor due to decomposing meats.	(Jordan and Carlson)
5.60	Destroys odor of casein leaving an excess of ozone.	(Franklin)
6.00	Causes coughing after moderate exercise.	(Hill and Aeberly)
9.00	No effect on bacteria exposed for three hours.	(Jordan and Carlson)
10.00	Fifteen-minute exposure causes sore throat.	(Jordan and Carlson)
20.00	Exposure for two hours may prove fatal.	(Hill and Flack)
137.00	Preserved eggs 50 days without detecting mildew.	(Franklin)
245.00	Reduces tobacco smoke (marked clearing of dense smoke noted within one hour).	(Franklin)
500.00	Required for germicidal purpose.	(Rideal)

OZONE PRODUCTION IN RELATION TO POWER CONSUMPTION

Experiment No. 4: (four tests).

This experiment was conducted to further familiarize ourselves with the performance of the apparatus. It was conducted with a constant air velocity under practically constant air conditions but with a varying voltage.

Experiment No. 5: (five tests).

This experiment was to determine the relation between ozone

—EXPERIMENTAL DATA—

EXPERIMENTERS	TEST NO.	WET BULB TEMP F°	DRY BULB TEMP F°	+AIR VEL. AT OPENING TO CABINET	NO. STROKES OF PUMP	++NO. DROPS $N_2S_2O_3$	O_3 CONC. PARTS PER M.	METER READINGS PRIMARY CIRCUIT WATTS	AMPS.	VOLTS	CALCULATED VOLTAGE
EXPERIMENT No. 4											
E.V.H. J.J.A. J.D.	1	66	78	596	8	6	9.6	100	1.5	120	6250
"	2	67	80	603	8	6	9.6	100	1.5	120	6250
"	3	67	80	600	13	6.5	6.4	50	1.0	95	4950
"	4	67	80	607	62	6	1.2	18	0.3	66	3440
EXPERIMENT No. 5											
J.J.A. J.D.	1	63	77	600	9	6.5	9.2	120	1.28	129	6630
"	2	62.5	76	613	9	5.5	7.8	90	1.08	119	6220
"	3	63	77	602	13	6	5.9	65	0.90	104	5440
"	4	63	77	607	30	6	2.6	30	0.58	84	4380
"	5	63	77	598	65	6	1.16	15	0.40	65	3380
EXPERIMENT No. 6											
E.V.H. J.J.A. J.D.	1	63	74	630	8	.5	8.3	82	1.04	117	6100
"	2	63	74	624	8	.5	8.3	82	1.04	117	6100
"	3	62.5	73	507	5	.5	12.3	82	1.03	116.5	6080
"	4	63	74	500	5	.5	13.3	81	1.04	116.5	6080
"	5	62.5	74	428	4	4.5	14.8	81	1.04	117	6100
"	6	63	74	323	4	5	16.6	82	1.02	116	6050
"	7	63	74	268	4	5.5	18.3	82	1.04	116.5	6080
"	8	63	74	114	2	5	33.4	82	1.04	117	6100
"	9	63	74	0	2	14	58.8	82	1.04	117	6100

+VEL. IN FEET PER MINUTE ++ONE DROP IS EQUAL TO 0.0087 C.C.

EXPERIMENTAL DATA OF EXPERIMENTS 4, 5 AND 6

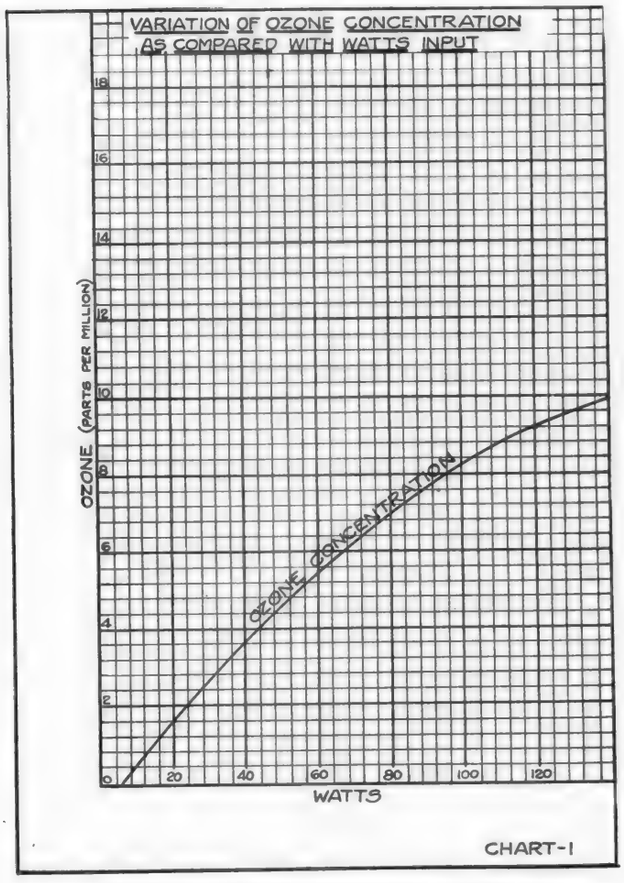


CHART 1—OZONE PRODUCTION CURVE.

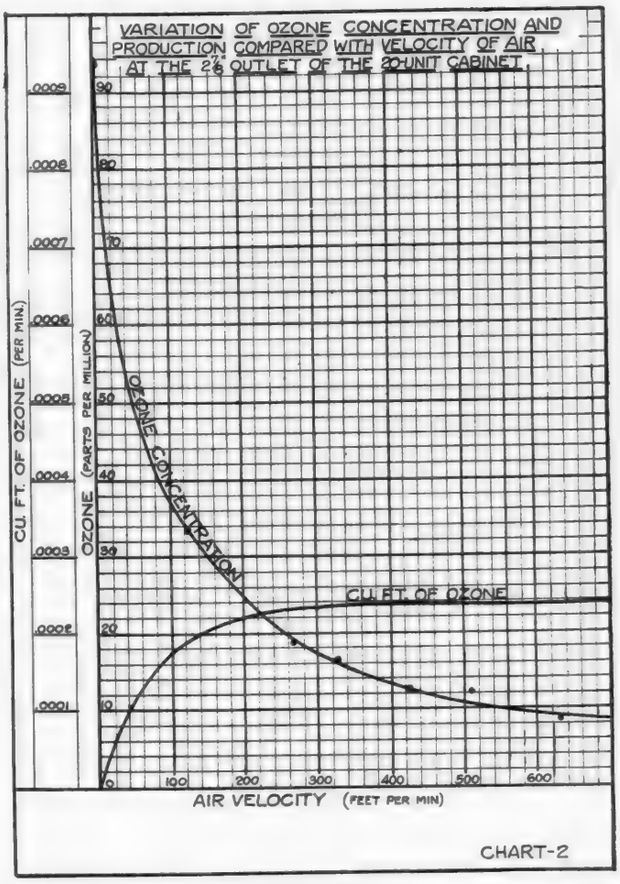

VARIATION OF OZONE CONCENTRATION AND PRODUCTION COMPARED WITH VELOCITY OF AIR AT THE 2½ OUTLET OF THE 20-UNIT CABINET.
CU. FT. OF OZONE (PER MIN.)
OZONE (PARTS PER MILLION)
OZONE CONCENTRATION
CU. FT. OF OZONE
AIR VELOCITY (FEET PER MIN)
CHART-2

CHART 2—OZONE PRODUCTION CURVE WITH VARYING AIR VELOCITIES.

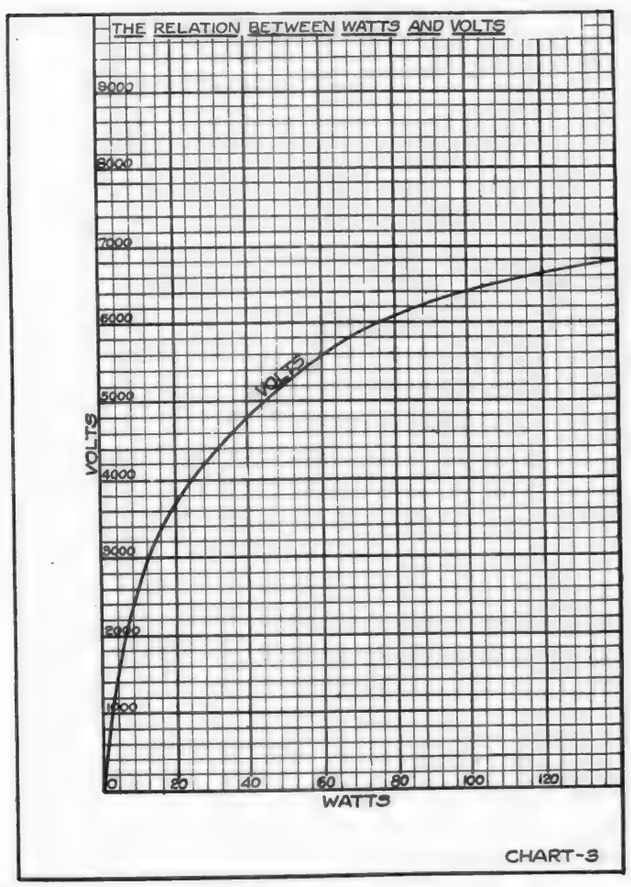


CHART 3—RELATION BETWEEN WATTAGE AND VOLTAGE IN 20-UNIT OZONE MACHINE.

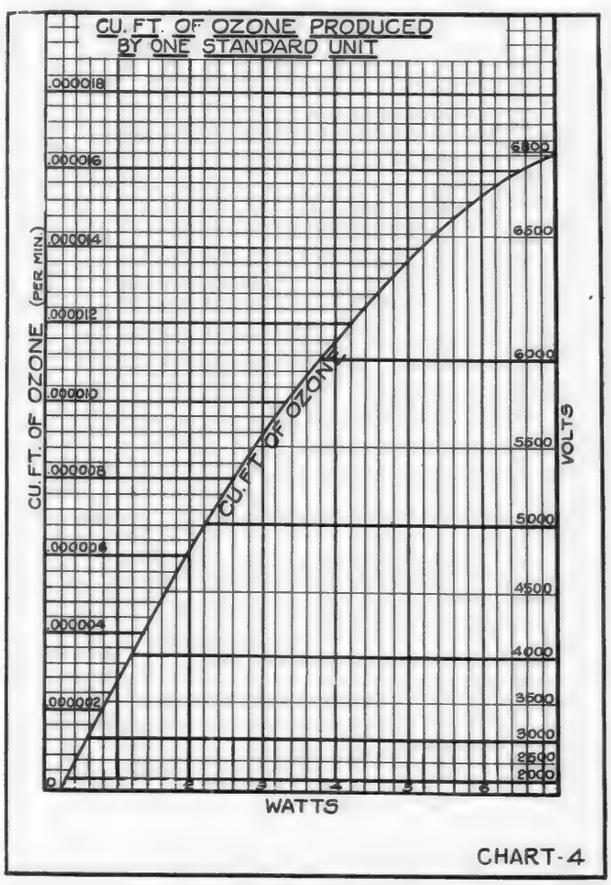


CHART 4—OZONE PRODUCTION IN RELATION TO WATTAGE AND VOLTAGE, BY ONE STANDARD UNIT.

production and power input. This test was conducted with no variation in either wet or dry-bulb, but with a varying power input.

Experiment No. 6: (nine tests).

Experiment No. 6 was conducted with a constant wet and dry bulb, a constant power input but with a varying air velocity through the machine. The results of the three experiments are tabulated herewith: See table, Page 30).

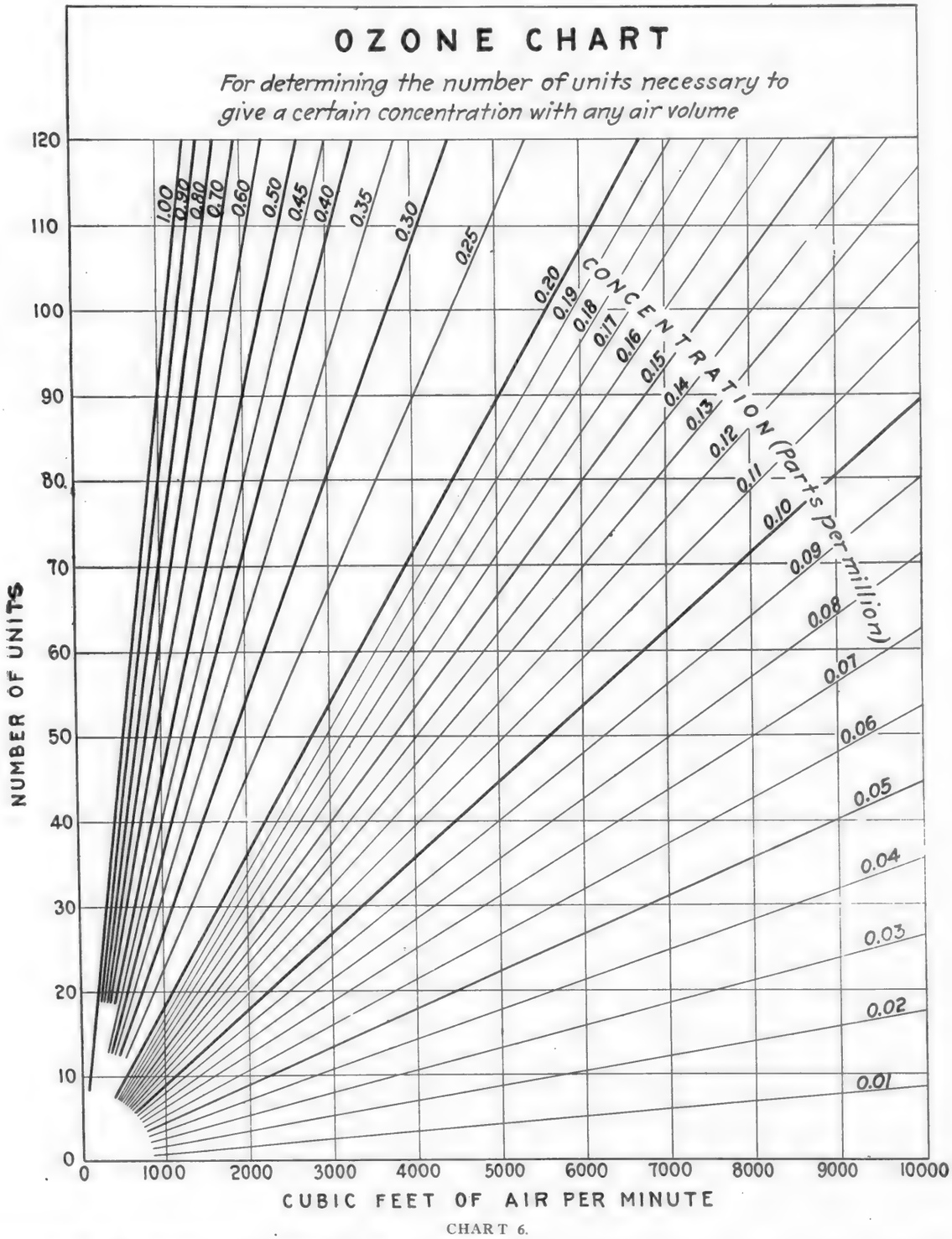


CHART 6.

Experiment No. 4:

This experiment gave very consistent results. It will be noted that the ozone concentration was constant where the power input was constant, as shown by tests 1 and 2, being 9.6 parts per million in each test. The concentration dropped to 6.4 in test No. 3, with a drop in the voltage from 6,250 to 4,950 and to 1.2 in test No. 4, with a voltage of 3,440. This test indicated that we should anticipate no trouble with the satisfactory and consistent operation of the apparatus.

The ozone production curve, chart No. 1, was plotted from the results of Experiment No. 5. The popular idea is that ozone production from a given machine depends upon the voltage. This, however, is not the case, as the production depends upon the total power input. For the twenty-unit machine used in this experiment the ozone increases with the wattage in the relation shown by the curve.

Chart No. 2 was plotted from Experiment No. 6. In this experiment the velocity of air passing through the machine

was varied, as previously stated, from 630 down to 0 ft. per minute.

The voltage was practically constant in the nine tests made. This chart (see concentration curve) gives the concentration of ozone at the outlet of the machine from 0 velocity to 700

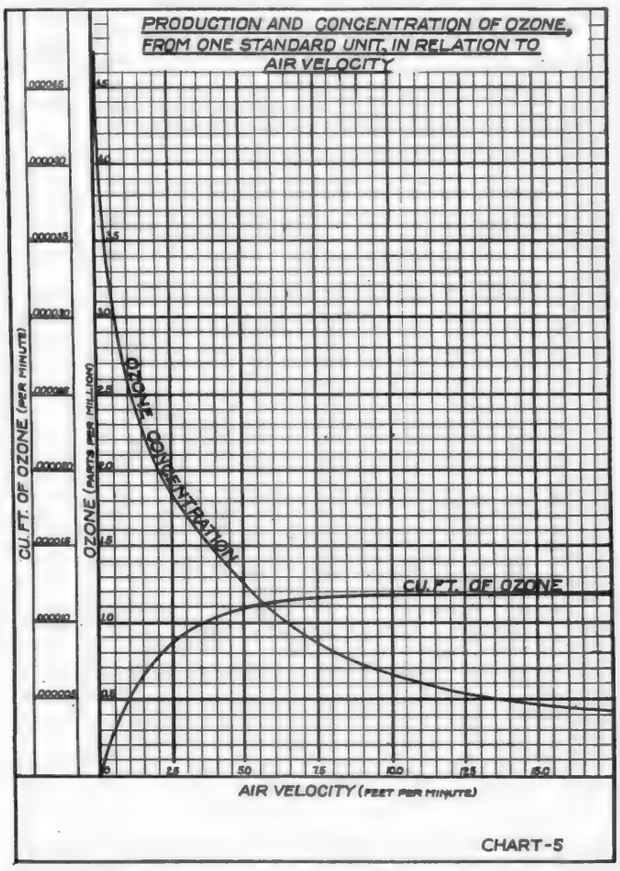

PRODUCTION AND CONCENTRATION OF OZONE, FROM ONE STANDARD UNIT, IN RELATION TO AIR VELOCITY
CU. FT. OF OZONE (PER MINUTE)
OZONE (PARTS PER MILLION)
OZONE CONCENTRATION
CU. FT. OF OZONE
AIR VELOCITY (FEET PER MINUTE)
CHART-5

CHART 5—PRODUCTION OF OZONE FROM ONE STANDARD UNIT IN RELATION TO AIR VELOCITY.

ft. per minute, the concentration varying from 94 parts per million at 0 velocity to slightly more than 8 parts per million at the maximum velocity. In studying this curve we raise the question as to whether the ozone production increases constantly as the air passes over the unit. This question is answered by the lower curve entitled "Cubic Feet of Ozone," which is obtained by multiplying the concentration as indicated by a given air velocity with the quantity of air passing through the outlet from the machine. By observing this curve it will be noted that the rise is abrupt but that it very soon flattens out, reaching a maximum at 400 ft. per minute with no change beyond this point. It should be noted that the velocities on the chart are of the air leaving the machine, which is not the true velocity of air passing around the units.

Chart No. 5 is compiled from the same data, namely Experiment No. 5, except that the results are plotted on the basis of the performance of one unit instead of from the entire machine, and the air velocities are the computed velocities around the units, instead of at the outlet. It will be seen from chart No. 5 that the maximum production is reached at a 10 ft. per minute velocity of air passing over the unit.

It is clear from this test that machines may be installed in practically any part of the ventilating system, insofar as velocity is concerned, without changing the production, as it would be exceptional indeed to find a velocity lower than 10 ft. per minute, and any velocity above this would not change the production of ozone.

Chart No. 4 is a convenient arrangement of showing ozone production in relation to voltage and wattage, based on the performance of one standard unit. The engineer desiring to use ozone equipment usually wishes to know the amount of ozone to be obtained from a standard unit, what voltage is required and what will be the power consumption. Chart No. 4 is arranged to answer these questions. It must be borne in mind, however, that this chart is applicable only to the type and size of unit tested. On the right margins of the chart varying voltages are shown. Taking as an example 6,000 volts and following this line to the cubic feet of ozone curve it will be seen that a production of 0.0000112 cu. ft. of ozone will be obtained from one standard unit with a power consumption of 3.8 watts.

Chart No. 3 is a curve developed to show the relation between wattage and voltage for this type and size of machine, namely, 20 units, and gives a fair idea of the power factor. This chart is based on data obtained in Experiments 5 and 6.

Chart No. 6 (ozone chart) was plotted for convenience in determining the number of standard units required to give a certain concentration with a given air volume.

PRODUCTION OF COAL CAN BE MADE UNIFORM

That there are no unsolvable technical difficulties in the way of the plan recently suggested by President Harding to the American Mining Congress whereby the production of coal might be made more uniform, and conditions of unemployment ameliorated and seasonal periods of depression largely obviated in the mining industry by the provision of storage reservoirs in which coal could be stored in quantity by large consumers and producers, is declared by Dr. H. Foster Bain, director of the Bureau of Mines. Careful analysis may show an extremely slight loss in the heating value of most bituminous coal after storage for a considerable period, says Dr. Bain. This loss, however, is very much smaller than is commonly supposed by the public, and in burning the coal little or no difference can be distinguished. Certain coals have an extra market value when carefully sized; handling these coals in and out of storage causes some breakage and may lower slightly the market value of particular coals, but this loss in value relates largely to the availability of the coal for certain classes of equipment and for certain uses, rather than to its actual heating value.

Spontaneous combustion in coal, the most troublesome factor in handling large storage piles, can be prevented, if proper methods of storage are adopted.

"The adoption of a general policy which would provide reservoirs of bituminous coal to be drawn upon in times of great demand or of low production is entirely a commercial question," continues Dr. Bain. "If the producer, or the dealer, or the large consumer, could produce or buy coal in the spring or summer for a price low enough to justify the cost of putting coal in storage and its rehandling, minus a fair insurance rate that he would be guaranteed a continuous supply in time of need, storage would become common."

MECHANICAL EQUIPMENT FOR A MACHINE SHOP

An Example of Western Practice Illustrated in the Installation for the Kilbourne & Clarke Mfg. Co., Seattle, Wash.

By ERWIN L. WEBER, E. E., M. E.

THE building occupied by Kilbourne & Clarke, Mfg. Co., in Seattle, Wash., manufacturer of radio apparatus, was built during the fall and winter of 1918-1919. It is in the shape of a letter E, comprising a machine shop 100 ft. wide by 300 ft. long. One end wing, 60 ft. wide by 100 ft. long, is used for a laboratory and a similar wing is used for storeroom purposes. The middle wing is 60 ft. square and is used for offices.

Concrete was adopted in the construction of the walls and outside columns while the interior construction is of wood. The windows are 12 ft. 6 in. high and comprise practically the entire outside wall space. The roof is constructed of 3-in. planking covered with asphalt, gravel and composition roofing. A craneway is provided along the entire length of the machine shop. The craneway has windows 6 ft. high on each side. Sawtooth construction is used over the machine shop, craneway and laboratory and gives exceptionally well-lighted interiors.

PRELIMINARY ESTIMATES

Preliminary estimates were made based upon a two-pipe vacuum steam system and upon a two-pipe forced water heating system. On account of the numerous doors in the outside walls it was imperative that with a steam system the major portion of the return piping would have to be run in trenches with cover plates and these pipes would require covering, thus losing the heating value thereof. With the forced water heating system the returns could be run on the ceiling, with no covering, and would serve as heating surface, as the greatest amount of exposure was near the roof. Due to the absence of vacuum traps, covering on the returns, trenches and cover-plates, and the decrease in pipe sizes the forced water heating system was found to cost about $3000.00 less.

The radiation was estimated upon the following basis: machine shop 65° F., store room 55°, laboratory 68°, offices 70°. Outdoor temperature, 25° F. with the water used for heating at 200° F. No account was taken of the heat generated by the various machines as these were mainly of small size and power.

OUTSIDE STEAM SUPPLY USED.

Steam is obtained from the Elliott Bay Mill, located about 500 ft. away and is transmitted underground through a 3-in. main; the pressure at the converter is about 50 lbs. gauge. The converter is a Patterson No. 14F, controlled by a Johnson hydraulic thermostat. The circulating pump is a 4-in. direct-connected electric-driven centrifugal pump made by the Moran Mfg. Company, of Seattle, Wash. All of this apparatus, including heater, pump, hot water generator and storage tank and two air compressors are located in a lean-to in back of the machine shop.

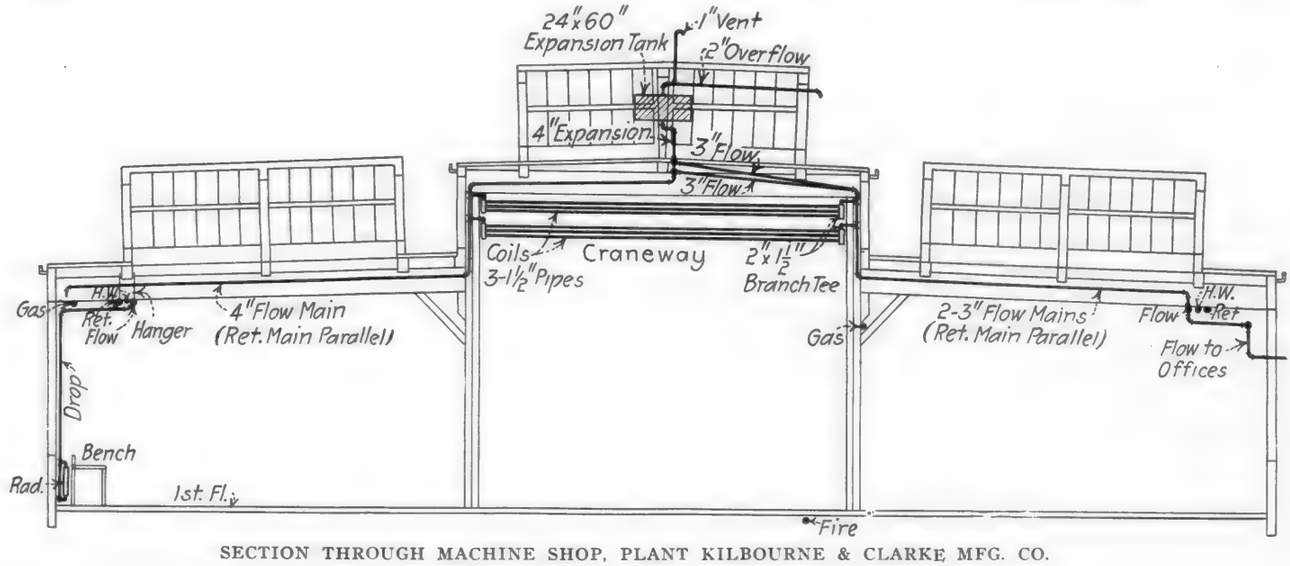
ARRANGEMENTS OF WALL RADIATORS

All radiators are of the Peerless wall-type, except a number of 3-col. and 4-col. radiators which were salvaged from the old plant. The wall radiators are fastened to the walls by means of lag screws and expansion shields. A pipe spacer is used in the rear of the radiators to hold them about 2½-in. from the wall and a washer is used in the front. In the machine shop and laboratory the back surface of the benches is about 6 ft. away from the wall, thus giving a very effective type of radiator setting.

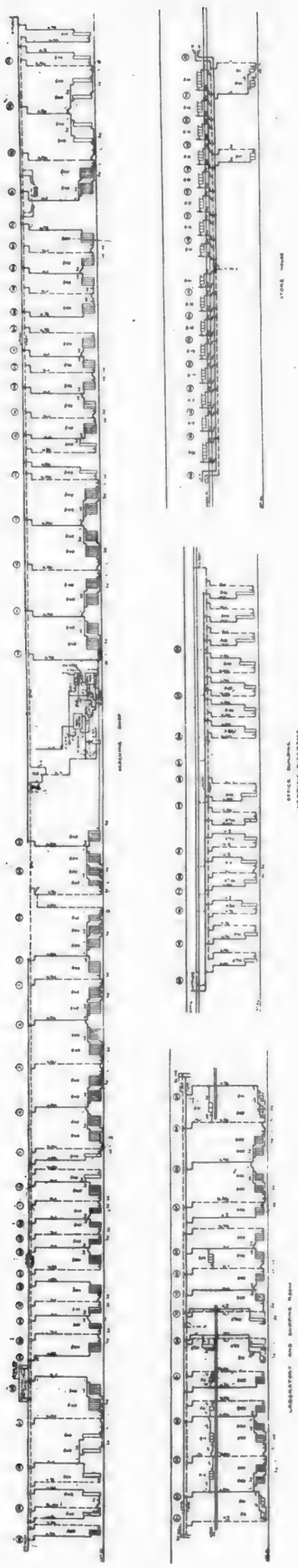
THE PIPING LAYOUT.

A 4-in. flow main leaves the heater and passes across the building, clearing the craneway, to the expansion tank. From that point two 3-in. flow lines extend to the opposite sides of the building, one passing to the right and the other to the left. They then extend around the entire periphery of the shop. The return mains follow along the flow mains, forming a loop system and unite near the heating plant into a 4-in. main which connects to the pump.

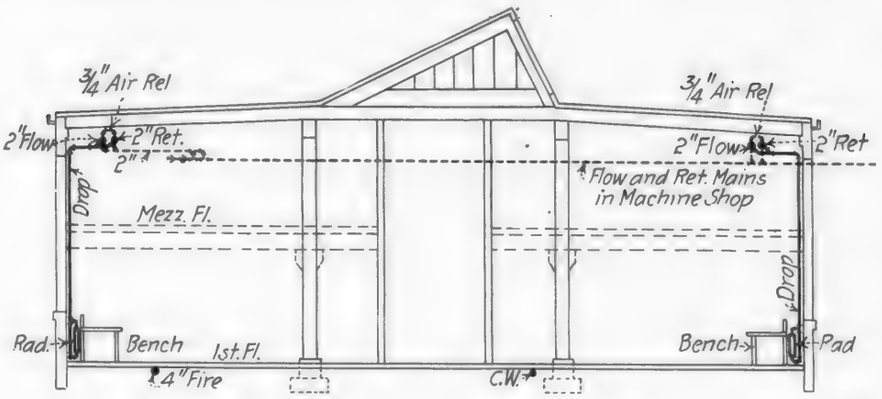
In the craneway are placed two groups of coils, one for each side. Each group is composed of two coils, and each coil contains three 1½-in. pipes. These are connected so that the direction of flow in one coil is in the opposite direction from the direction of flow in the other, so that the cooling of the water in the two coils is equalized. Each coil is pro-



SECTION THROUGH MACHINE SHOP, PLANT KILBOURNE & CLARKE MFG. CO.



HEATING DIAGRAMS, PLANT OF KILBOURNE & CLARKE MFG. CO.



SECTION THROUGH LABORATORY, PLANT OF KILBOURNE & CLARKE MFG. CO.

vided with a valve in the flow and return connection. The longest coils are over 400 ft. in length, but when they are turned on the crackling and hammering sound usually found in steam coils is entirely absent. These coils proved very effective in preventing cold down-drafts in the middle of the shop.

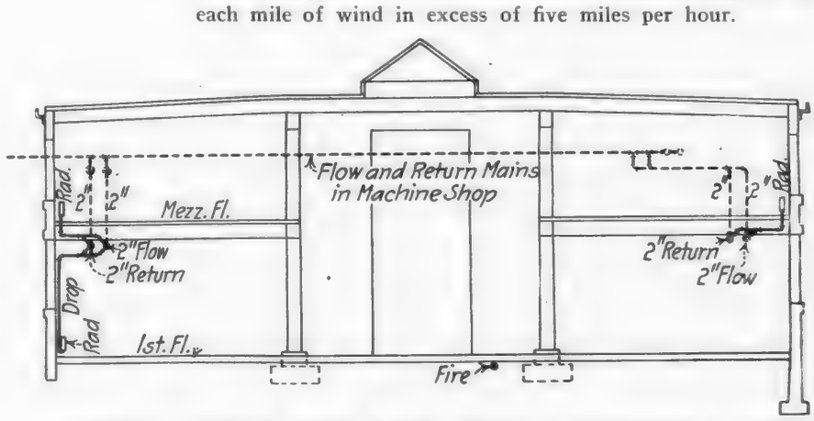
The laboratory, offices and store room are treated in a similar manner. All radiators are fed by drop risers. The flow enters at the top and the return leaves at the bottom of the radiators. The piping is graded to relieve all air to the expansion tank. No covering was used outside of the convertor room and all pipe work serves as radiating surface.

The returns pass through the pump to the convertor. A by-pass is provided around the pump. The condensation tank consists of a water storage tank with coils through which all steam condensation passes. This pre-heats the water for the domestic hot water supply and at the same time sufficiently cools the return condensation so that it may safely pass through the meter to the sewer. The domestic hot water is further heated in a Tobey heater.

This plant has been in operation for two seasons and at all times maintained a comfortable temperature throughout every portion of the building. The operation was carried on according to the following schedule of temperatures. The temperature of the water represents the average of the flow and return temperatures.

Outdoor Temp. Deg. F.	Temperature of Water Deg. F.
70	70
60	92
50	112
40	132
30	182
20	200

The temperature of the water was increased about ½° for each mile of wind in excess of five miles per hour.



SECTION THROUGH STORE HOUSE, PLANT OF KILBOURNE & CLARKE MFG. CO.

The plumbing consists of toilet accommodations, wash rooms and process sinks, rain conductors, fire and water systems and gas system. The main sewer lines are run on the outside of the building so that vitrified tile pipe could be used. Cast iron soil pipe is used inside of the building. The water closets are connected on the loop vent system. A basin for washing automobiles and trucks is installed in the courtway adjacent to the laboratory. All the sewer and drain lines lead to a basin at the southwest corner of the machine shop from which connection is made to the city sewer.

The cold water service enters at the southeast corner of the building and runs underground, supplying the various fixtures and fire hose outlets.

The domestic water heating service is arranged on a circulating system. The main loop passes around the entire machine shop and is over 800 ft. long. By using pipe bends only in this main it was found that the water circulated without the use of a pump.

Gas is provided for process work at the various machines and to the benches. Several gas forges and tempering furnaces are installed.

The heating system was installed by P. J. Lavan & Co., Seattle, at a cost of about $9000.00 and the plumbing by Norton & Spangler, Seattle, at a cost of about $6000.00. These installations were made when prices were at the high peak.

Carl Siebrand, A. I. A., Seattle, was the architect of the building and Erwin L. Weber, E. E., M. E., was the consulting engineer for the heating and plumbing equipment.

AN ANALYSIS OF THE PROCESS OF HEAT LOSS FROM WARMED BUILDINGS

The Scientific "Reason Why" of Familiar Phenomena Observed in Heating Work

By S. HOMER WOODBRIDGE

EDITOR'S NOTE.—*The analysis here presented is intended as an introduction to a forthcoming paper by Professor Woodbridge on "Construction Features in Their Bearing on Heat and Fuel Economy," which will appear in an early issue.*

THE processes of heat loss from warmed buildings may be described under two general heads; transmission through walls and air leakage. As a matter of fact, the processes are complex both as to transmission and to leakage.

FIVE PROCESSES INVOLVED IN HEAT LOSS BY TRANSMISSION.

The transmission of heat through a solid wall of a warmed building involves five processes; (1), absorption of heat by the inner surface of the wall by the two methods of convection and radiation; (2), the passage of heat through the wall from the inner and warmer surface to the outer and colder surface by conduction; and, (3), the escape of heat from the outer surface to the colder surroundings by the dual processes of convection and radiation. By as much as a wall is hollow, or porous, there is added for each traversed air space the intermediate processes of convection and radiation.

HEAT ABSORPTION BY THE INNER WALL SURFACE OF EXPOSED WALLS.

The random and high-frequency vibratory movements of the molecules of air and other gases, or of vapors, in contact with the fixed molecules of a solid surface impart some of their kinetic energy of motion to the molecules of the solid. The rate of such impartation depends upon, and is directly as, the difference between the energies of the vibratory motions of the atmospheric, gaseous or vaporous molecules and those of the solids. The form of molecular energy so yielded by the air, gas or vapor and imparted to a contacting surface, technically termed thermal energy, is what is commonly known as heat. Temperature being the measure of molecular thermal energy, the rate of heat transfer, therefore, varies directly as the temperature difference between contacting air and the surface with which contact is made. The transfer is in both directions, and the net result is one of differentiation. Heat is said to "travel" in the direction of the major movement.

The physical character of the material of which the wall is made up, also the nature of the surface as to roughness and smoothness, have no appreciable effect upon the rate of transfer by the convection method.

The rate of the movement of air, gas or vapor over the surface of a solid has a marked effect upon the rate of heat transfer. Such movement is essentially one of displacement, the molecules in temporary contact being dislodged and their place taken by others less effected by contact. In the case of air yielding heat to a cooler wall surface, the trend of air movement is downward over the cooling wall, and the process of displacement removes molecules partially chilled and substitutes for them molecules of higher temperature. The effect of rapidity of air flow over surfaces of another temperature than that of the air is made sensible by the rate of heat transfer when air warmer or cooler than the dry skin of face or body is moved over it by the action of a fan or the wind.

EFFECT OF HIGH CEILINGS

Under the ordinary modes of heating, and unless the air within an enclosure is rapidly changed and churned by energetic ventilating processes, the temperature of air at the ceiling is higher than that at the floor, and the temperature differences between wall and air are greater at that level than at lower levels. Because of greater density, the air chilled by wall contact at this level falls floorward and is followed by other bodies of air moving in the same direction. The higher the ceiling the greater the acceleration of the air movement during the progress of precipitation, and consequently the greater the rate of heat transfer from air to wall.

The effect of the lowering temperature of the air as it falls only in part offsets the effect of increased velocity, the net result being an increase in thermal transfer per unit of wall surface with increase in the height of ceiling. Hence the triple effect of high studded rooms on the rate of heat loss from such rooms; first, because of a larger cooling surface presented by the wall; second, because of the more rapid rate of heat transfer due to the higher velocity of air flow over the surface; and, third, because of the higher mean temperture of the air of the room made necessary for a comfortable floor temperature. It has been the writer's custom to add 1% to the rate of heat loss for each 2 ft. of height of ceiling above 10 ft.

EFFECT OF AQUEOUS VAPOR IN THE AIR

The specific heat of aqueous vapor is more than twice that of dry air. Moist air, therefore, has a greater thermal capacity than dry air, and consequently yields more heat to a cooling surface than does dry air. It is because of this fact that moist air having a lower temperature than the body feels colder when impinging on the body than dry air at the same temperature, or if the moist air be warmer than the body, it feels sensibly warmer than dry air at the same temperature having the same motion. If the moisture in air condenses on, or is absorbed by the surface with which it contacts, the heat yield is increased by that of the latent heat of condensation.

RADIATION OF HEAT TO COOLING WALL.

Heat transfer by radiation is in reality a three-fold process, involving first, the relatively fixed, but actively vibrating, molecules making up the surface of any heat radiating body; second, the imparting of that vibratory movement to the omnipresent and all-pervading ether in contact with those molecules, and the creation of ether waves of equal frequency pulsation and of inconceivable velocity; and, third, the impinging of those waves upon the molecules of the surfaces of any material intercepting the paths of the thermal rays, and the imparting of vibratory motions to those molecules of such type as is popularly known as heat. The radiation process, therefore, involves a radiant, a medium, a recipient, and a double change in the phase of the involved motions. The process is reciprocal, though seldom equal, and the apparent "heat travel" is nothing other than a differential travel of thermal energy, and the net result one of differential transfer, the direction of major movement indicating the direction of so called "heat flow."

In the case of a wall, or walls, of a room cooler than other surfaces exposed to them, such as inside and warmed walls, ceilings, floors, furniture, exposed heaters of any kind, lamps, occupants or any other material within the enclosure, radiant heat passes from the warmer to the cooler surfaces in excess of heat transit in the opposite direction, the effect being to raise the temperature of the cooler, and to lower that of the warmer, surfaces. The amount of heat so transmitted is frequently as large as, and sometimes larger than, the heat transference from air to those surfaces by the convection process.

If all the wall surfaces are those of outside and of equal exposure and temperature, the heat radiated anr absorbed, as between such walls alone is, of course, equal, and the effect of thermal exchange between them is then nil. Therefore in the case of all walls exposed, there being then no warm walls to transfer an excess to the outside walls, the heat received by such walls is less than when heat is radiated from warm walls, and the cooling rate per unit of area through them is by so much reduced. Hence the maximum rate of heat loss per unit of wall area of an enclosure is when the exposed area bears a minimum ratio to the total wall area, and becomes the least when those proportions are reversed.

Air temperature and movement have no other effect on heat transference by radiation than as they affect the temperature of radiant or recipient surfaces, or both. The physical character of surfaces, that is the material of which they consist, and the nature of the surfaces, whether rough, smooth or polished, effect thermal radiant exchange to a marked degree. So also does the state of wetness or dryness of surfaces, whether by water or oil, as both substances are of high radiant power. The smoothness and roughness of surfaces largely affect the extent of surface of materials, and therefore of molecular exposure to ether. The difference between microscopic and ultra-microscopic superficial surfaces, polished or rough, is like that between level plains and the same plains densely covered by great and ragged mountains.

Such, in outline, are the processes by which heat is taken up by the inner surfaces of the cooling walls of a building or room, including a summary of the conditions which affect the rate of heat transfer to such walls.

HEAT TRAVEL THROUGH WALLS.—CONDUCTION.

Conduction of heat consists in the communication of the vibratory motion, or thermal energy, resident in the molecules of an immobile substance to molecules in immediate and close proximity. It is by such imparting of energy from molecule to molecule that heat is said to travel through solids. The quantity rate of travel is dependent, first, on the difference between the thermal energies, or temperatures, of molecules in close proximity; second, on the specific conductivity of the substance; and third, on the thickness of the material traversed. The rate varies directly with, and as, the conductivity, directly as the temperature difference between the receiving and emitting faces in case of a wall, and inversely as the thickness of the material, or distance between those two faces.

The filling of the pores, or interstices, of a material by any substance which displaces the otherwise contained air materially affects the conductivity of that substance. Multitudinous and minute chambers which, in the material when dry, must be thermally traversed by the processes of convection and radiation, when water filled contain a material of more than four time the specific heat of air, and one far more active than air as a convecting medium. The high insulating value of porosity in wall materials is due to the large number of air cells which break up the continuity of material, and therefore the conduction process, and to the consequent multitudinous substitutions of convection and radiation for the process of conduction in bridging all such spaces.

ELIMINATION OF HEAT FROM THE OUTER SURFACES OF COOLING WALLS.

The processes of heat escape from the outside surface of a cooling wall are the reverse of those by which heat is imparted to the inner surface of that wall. The direction of heat travel by convection is from the wall surface to the contacting air, the laws of transfer being the same as those pertaining to thermal travel from air to wall on the warmer side of the wall. The principal exception in the process is in the practical effect of the upward movement of air currents over the air warming wall attending the convection process upon the outer surface. The high velocity of wind, and the rapid displacing action of wind, dwarf to a negligible insignificance the effects of any theoretical increase in convecting activity due to rising currents of air in accelerating ascent over the warming walls, such currents being possible only at times of calm approaching the absolute. Wetness of wall, or of air, or of both, increases the convecting rate.

RADIATION FROM THE OUTSIDE SURFACE OF WALLS.

Radiant heat from the outer surfaces of walls is intercepted by all surrounding surfaces, such as the earth, foliage, the walls of adjacent buildings or structures, atmospheric dust, haze, fog, the clouds. All such material receiving, and to some extent absorbing, the energy of the emitted thermal rays, becomes more or less heated by them, and to that extent returns to the thermal emitting surface some of the energy so received. All thermal waves passing into the space of a clear sky, where there is but a trace of any intercepting medium, are but feebly reciprocated in thermal exchange. The presence of atmospheric dust, smoke, haze, fog, clouds, intercepting radiation, produces corresponding reciprocation, and hence the ultility of clouds and smoke in preventing frosts. The rate of heat loss from a horizontal surface exposed to a clear sky is therefore in excess of that from a like surface in a vertical position, because of the non-intercepting of emitted thermal rays and the consequent absence of reciprocal exchange.

The effect of the nearness and extent of the walls of warm buildings, as in the case of city streets and blocks, is of

economic value. Radiant solar heat largely effects the heat yield from surfaces exposed to solar rays. From surfaces so oriented as to be unaffected by solar rays, the higher rate of thermal emission is not so compensated by solar effect. Manifestly, therefore, on a clear day the rate of heat loss is greater from the northern exposure, for any given surface, than from a like surface having any other compass exposure. At night under a clear sky and in quiet weather the rates of thermal loss are practically equal per unit of area for all points of the compass. Under a clear day sky the north wall becomes the maximum, and the south wall the minimum, aggregate loser, wind effect being eliminated from consideration.

In general, the weather conditions within a warmed building are those approaching uniformity, and those without are widely variable as to temperature, air movements, wetness and dryness, sunshine and shade. Given fixed inside and outside temperatures, any change in any one of the several modes of heat loss is automatically matched by changes in the other modes in a manner to preserve the thermal balance. If, for instance, the conductivity of a wall is so decreased that heat transmission is reduced, the temperature of the inner surface is automatically raised and that of the outside surface is lowered, and less heat is yielded to the inside surface and also by the outside surface.

Notwithstanding the considerable fluctuation in the rates of heat loss due to the several causes noted, it is yet quite within the range of possibility to so compute, for any building and exposure and state of sky, the probable rate of heat loss for any fixed difference of inside and outside temperatures as to adequately provide for that loss by a selected and well adapted heating system.

EQUALITY OF PROCESSES

The rates of absorption by, of transmission through and of emission from any wall are of necessity equal; for only that quantity which has been received can be transmitted, and only that which has been transmitted can be emitted. Because of these basal facts it is possible to reduce to mathematical formulas the laws of heat transmission through walls when only the temperatures of air surroundings on both sides the walls are known, and the specific conductivity and the thickness of wall materials are specified.

COOLING OF BUILDINGS BY AIR LEAKAGE.

The rate of cooling by the inward and outward movement of air through the walls and roofs of buildings may be, and not infrequently is, greater than that by transmission through walls. Such movement is by two processes, one the differential movement of molecules through pervious material because of a difference of gaseous density under pressure, or of a difference of temperature of gases upon the two sides of a porous wall; the other the movement of air in measureable current and volume through all avenues of whatever minute or larger size open to its passage under pressure difference producing flow. Both methods may be included under the one head of "spontaneous" ventilation as contrasted with "artificial" ventilation.

MOLECULES AND MOLECULAR MOVEMENTS.

The infinitesimal size of gaseous molecules, the infinitude of their numbers, the intensity of their action, the openness of much of building material to molecular travel are matters to which little consideration or value is given because the entire field lies in the realm of the invisible. The infinitesimal size and the infinite numbers and the prodigious activity of such molecules, though beyond all human conceiving, may yet be so pictured as to bring them within the visionary grasp of human mentality.

From data furnished by Lord Kelvin the writer has made the following general computations: If from an air-filled cubic inch of a confined space at 30-in. and 32° F. atmospheric molecules escape at the rate of 100,000 per second, the time required to completely void that space of such molecules would be in excess of 109,000,000 years. The size of the molecules approximates 1/30,000,000th of an inch in diameter; the average molecular spacing approximates 4½ molecular diameters; the average rate of impact to which each molecule is subjected per second from its environing neighbors is estimated at approximately 4.7×10^9, and the mean molecular velocity is 1150 ft. per second, all in zigzag and broken fashion because of the high frequency of the impacting rate. Only in a vacuum can molecular motion be in right line.

A MOLECULE OF AIR LIKENED TO AN ORANGE

Appropriate to the present discussion the relation of molecular size to the pores, or the interstices, of much building material may be pictured as follows:— the size of a molecule of air is to that of an ordinary orange as the size of such orange is to that of the earth. Let such orange be enlarged to the size of the earth, with all the proportions of fibre and of inter-fibre spaces maintained unchanged. The skin of the earth-size orange would then appear as though made up of a mesh of felled and mammoth trees, lying layer on layer hundreds of miles in depth with spreading branches and boughs unbroken and unbent. The interference of such a mesh to the travel of an orange falling through it may be readily imagined.

Even in free air the onward travel of molecules is very slow when compared with molecular velocity. By inconceivably rapid impactings the path of travel is zigzagged in every conceivable direction, and reversed tens of thousands of times each second. The so-called "flow" of air through a permeable wall is in reality no more than a differential flow, determined by a difference of pressure or of density, or a difference in temperature or molecular activity, upon the two sides of a separating wall. The greater density means that a greater number of molecules are moving into and through a given area of wall in any unit of time than are moving in the opposite direction. Higher temperature of air on one side of a wall than on the other means that the molecules of the warmer side have a higher velocity than have those entering the other side of the same wall. It is important that the differential character of air flow should be understood and accepted if the phenomena of the movement of gases and vapors under the action of either pressure or of temperature inequalities is to be understood and intelligently interpreted.

When to these normal conditions existing in free air which obstruct the onward movement of orange-sized molecules are added the further obstructions due to the presence of intermeshed tree trunks and branches thousands of miles in depth, the reason for greatly reduced molecular travel becomes apparent.

The volume of differential travel of gas through a pervious wall varies directly as the absolute pressure difference between the gases on the two sides of the wall, for the reason that pressure determines the molecular number difference, temperatures being the same on both sides of the wall. When temperatures are unequal and pressures are the same, because densities are then inversely as absolute temperatures, and molecular velocities are directly as the square root of absolute temperatures, therefore the relative numbers of molecules passing either way through an intervening wall may be indicated by the product of molecular numbers into molecular velocities, or

$$\frac{\sqrt{T}}{T} = \frac{1}{\sqrt{T}}$$

on either side of the wall, from which it appears that the differential movement or 'flow" of air under the conditions named is from the cooler toward the warmer side of a separating wall.

INSTRUCTION COURSE FOR CUSTODIANS AND JANITORS

Lesson No. 11—Cleaning With Vacuum Cleaning Machines

BY EDWIN S. HALLETT,
Chief Engineer, St. Louis Board of Education.

THE daily cleaning of buildings is required for at least two distinct purposes, viz: the removal of visible dirt and refuse and the removal of the fine invisible particles, commonly called dust. It is quite easy to remove the visible portion in a number of ways, the most common being the bristle broom used with moist saw dust. At the best this method has many limitations, and various efforts have been made to devise a perfectly satisfactory mechanical apparatus that would supplant the broom. The power-driven vacuum cleaner or sweeper has been evolved to perform this duty.

A vacuum cleaning system consisting of a vacuum producer which is the heart of the system and the hose and tool equipment, together with the piping of the building.

Vacuum producers are of two types, the fan type and the positive displacement type. The fan type equipment is divided into two classes, the multi-stage fan type and the single fan type. The multi-stage fans and turbine are divided further into two classes, the wide-clearance turbine and the close-clearance turbine. The positive displacement machines can be divided in two general classes, namely, the rotary pump and the piston pump type.

The rotary pump machines are of two types, the sliding-vein type and the figure 8 or two-impeller type of pump.

There is still another type of vacuum producer not mentioned above, that is the steam aspirator machine. This type, like many others, is practically obsolete. It is very cheap and also extremely expensive to operate.

The important consideration in vacuum cleaning is the vacuum which is produced at the tool where the cleaning takes place, or rather, the proportion of vacuum to volume that is maintained. Any system that will maintain these proportions will do good sweeping regardless of the make or type of producer used. The accepted standards for bare floor sweeping is 2 in. of mercury at the tool and for carpet sweeping 3 in. of mercury at the tool, as measured by a Spencer globe-type vacometer. These standards have been generally accepted by architects and engineers throughout the country. The Spencer globe-type vacometer consists of a globe of about 4 in. in diameter which is attached to the end of the hose. On the top of this globe is mounted a spring gauge reading in inches of mercury or a connection so that the globe can be connected to a mercury column.

Along the equatorial lines of this globe are a number of various size orifices corresponding to different floor tools.

A 7/8 in. orifice represents a 15 in. bare floor tool and will pass as much air through it, provided 2 in. of vacuum is maintained in the globe, as a 15 in. bare floor tool will pass while in operation on the floor. A 5/8 in. orifice with 3 in. of mercury vacuum will pass an amount of air equal to that passed by a 12 in. carpet tool while in operation on a carpet.

In testing a plant for capacity the usual number of hose lines are connected to the various risers and orifices representing the different tools which are attached to the hose. At one end of the hose the vacometer is inserted and the vacuum maintained on the system is read.

SELECTION OF A VACUUM PRODUCER

In the selection of a vacuum producer the type of apparatus which will give the greatest permanent overall efficiency should be selected. By permanent efficiency is meant a machine that would produce the same vacuum at the tool when it is ten or twelve years old as it did when it was first installed. The only producer on the market to-day which the writer has found to be free entirely from internal wear is the multi-stage wide-clearance turbine machine, the most satisfactory models of which are the low-speed horizontal type which have a clearance between moving and stationary parts of 1/8 to 1/4 of an inch. This means that it is possible to permit a certain amount of fine dust to pass through the vacuum exhauster. This should also permit the elimination of complications in the separator, making it possible to use a plain dry-type separator without any screens or cloth bags.

It is next to impossible to separate all of the finely-divided dust from the air. There will always be 2% or 3% which will be carried over from the separator and in the case of a close clearance type of exhauster this dust and dirt is the cause of considerable wear to the vacuum producer of the close-clearance type.

TYPES OF SEPARATORS.

Separators are of two general types, the wet and dry separators. The dry separator is merely a large tank with a baffle plate to prevent short-circuiting of the air through the separator. The wet separator, as its name implies, is one which is partially filled with water, the exhausted air being drawn through the water to relieve it of the fine dirt. The wet separating system usually consists of a wet and dry separator, the dry separator intercepting all of the heavy dirt, the last 2% or 3% of fine dust being carried over into the wet separator, the theory being that the air in passing through the water will be washed of the fine dust. Through the use of a number of baffles in the water, it will break up the path of the air and form it into a number of small bubbles. While this seems successful a certain amount of the dust remains inside of the bubble only to be carried on into the exhauster after the bubble bursts when coming to the surface of the water. This dust, of course, gets in its destructive work when carried into the close-clearance exhauster used with this type of separator.

The dry separator is one using a fine mesh metal screen or a cloth bag screen in the separator, the theory being that the screen or cloth bag will intercept all of the fine dust. This theory works out very well while the bag and screen are new. This fine dust and air will carry with it a certain amount of moisture which is released in the separator due to the expansion of the air. In the case of the screen, it, in due time, becomes clogged with fine dust and in many cases is weakened by chemical action to the point where the screen will break, resulting in a good portion of the heavier dust being drawn in the vacuum exhauster. This is also true of the cloth bag which becomes rotted and breaks, permitting the dust to enter the vacuum producer. It is also necessary in the case where the cloth bag is used to subject the bag to periodical cleanings in order to keep it from getting clogged and thus reducing the efficiency of the cleaner.

The screen and bag being closed up in the separator, it is impossible for the attendant to know exactly their condition until a sufficient quantity of dust has been passed through the exhauster to cause serious harm to take place.

THE PIPING SYSTEM

One of the most important parts of the vacuum cleaner system is the system of piping. The piping should be so designed that the friction loss expressed in inches of mercury

vacuum will not be greater than 2 in. of mercury in any part of the system. The piping should be so proportioned that an equal potential of vacuum will be maintained in every part of the system, regardless of the number of sweepers being used. This means that careful attention must be given to the amount of air that the pipe will have to handle and this friction loss accurately figured. The long sweeper bends should be used on all right-angle turns and clean-outs should be provided at the end of every horizontal run. A sufficient number of risers should be located throughout the building to be cleaned so that it is possible to reach every part with a 50-ft. hose and, in the case of cleaning school buildings, the most satisfactory and economical piping layout from the standpoint of maintenance is one providing an outlet in each room, located, if possible, at the front of the room, thus permitting the janitor to work up and down between the desks.

HOSE LINE

The hose used should be of sufficient strength to withstand the wear and tear to which it is subjected and at the same time it must be kept in mind that a reasonably light-weight hose is required. The friction loss on the hose line should not exceed the friction loss in the piping system. It is usually found in well-designed vacuum cleaner systems that it will amount to 2 in. of mercury vacuum with the friction loss in the piping system at 2 in. and the vacuum producer maintaining a vacuum of 6 in. of mercury. We have 2 in. of mercury available for sweeping purposes. This is based on the bare floor requirements. It has been found that 1½-in. hose is the happy medium as it permits a minimum of friction loss and a light-weight hose.

Where a hose smaller than 1½-in. is used the friction loss increases very rapidly as the size of the hose is reduced. The loss in a 1-in. hose vacuum is about ten times as great as the loss in a 1½-in. hose. This advantage, of course, offsets the fact that the 1-in. hose is much lighter in weight and much easier to handle. However, the 1-in. hose furnished in some of the old high vacuum systems was very stiff and in many cases heavier than the 1½-in. hose reinforced with the flat wired tape now in more general use.

TOOL EQUIPMENT

The tool equipment should be sturdy and of light weight. Steel tools have been found to meet these requirements best as they combine both features, durability and light weight. All of the cleaning tools should be provided with swivel adjustments to the stem or handle so that the operator may be enabled to reach into corners, under desks, chairs and other inaccessible places. The hose should be connected to the handle by means of an elbow joint of some kind which will relieve the operator of the weight of the hose and also take the strain off of the hose at the weakest point—the coupling. All tools should be provided with renewable wearing surfaces, and should also be provided with buffers to prevent injury to the furniture by accidental contact.

INLET VALVES

The most satisfactory type of inlet valve is one which closes automatically. Such a valve by necessity would have to be provided with a gasket which should, of course, be renewable.

The one great objection to stationary vacuum cleaners has been the interruptions and expense of the repairs on machines running at too high speed. Those vertical sweepers running at 3500 R. P. M. are not satisfactory. These annoyances have directed the attention of builders to portable machines, which will be the subject of the next paper of this series.

Questions

1. What are the principal reasons for using vacuum sweepers?
2. Make a diagram of the classification of vacuum cleaners.
3. What are the essential qualifications for a vacuum sweeper?
4. How are vacuum sweeper systems tested?
5. What are the special advantages of a multi-stage fan exhauster?
6. What are the objections to bag separators? To wet separation?
7. Where should the discharge of the exhauster be run?
8. What precautions are necessary in the piping layout?
9. How should the inlet valves be distributed,
10. What kind of hose is required?
11. What is the minimum pressure loss allowable for hose?
12. What are the objections of high speed motor drives?

BACK TO FIRST PRINCIPLES

Lesson No. 8--Humidification of Air for Breathing

BY REID DAVIES

AIR and water are warm friends but, as soon as any coolness springs up between them, they draw apart from each other, attaining various stages of estrangement from an attitude of dutiful concern through a simple bowing acquaintance to a complete lack of recognition. In this respect their relationship resembles many of the human variety, except that in the case of air and water the effect is less a matter of temperament than of temperature.

But this friendship has not always been subject to the same vicissitudes. If we may accept as true the Nebular Hypothesis of planetary evolution, there was a time, back in the earth's comparatively recent past, when it was no easy matter to decide just where the atmosphere ended and the hydrosphere began, so close was the blending of air and water—both gases at that time. However, the cooling process which had then resulted in freezing of the larger part of Earth's lithosphere, eventually led to condensation of the major portion of the steam in its gaseous envelope to water. It is interesting to note that no known organisms can live through prolonged exposure to temperatures approximating those of this period of condensation, although some very simple forms of life can survive slightly lower temperatures. From this it may be inferred that this period marked the start of organic life on Earth.

An idea of the earth's age, in terms of temperatures, may be gained by comparing the estimated present temperature of the sun, 10,000° to 12,000° F. (and the sun has also been cooling ever since Earth was born), with the temperature range of the steam condensation period, from several hundred degrees down to 212° F. (pressures were greater at the start of this process and initial condensation temperatures correspondingly higher), and with the present range of average temperatures from 80° F. at the equator to about—10° F. at the poles.

This digression from the subject of humidification is less real than apparent, since the problems incidental to that subject all spring directly from the gradual de-humidification of the atmosphere by this cooling process. More than that, the humidication problem promises to grow with continued cooling. Since, at existing atmospheric pressures there is but small temperature range between the condensation of steam to water and the freezing of water to ice, the latter process has overlapped the former and much of what was once part of earth's liquid content has become a fairly permanent part of its solid structure.

FACTORS AFFECTING HUMIDIFICATION.

As might be anticipated, the factors controlling humidification fall into two groups, those relating to air conditions and those connected with the water which is in contact with this air.

Perhaps the most obvious factor involved in the problem of humidifying air for breathing, is that of air temperature. To understand this fully it is necessary to recognize that relative humidity is the point of primary interest in this problem, not absolute humidity. The two are inseparably related, but it is the relative humidity which produces the results, good or bad, and forms the connecting link between absolute humidity and temperature.

A certain amount of water vapor in a unit volume of air (the absolute humidity of that air) will give it a high relative humidity at low air temperature and a low relative humidity at high air temperature. Measurements of absolute humidity are made in terms of weight of water contained in a unit volume of air, while relative humidity is expressed in percentages, with the saturation point taken as 100% relative humidity. Another way to define relative humidity is as the ratio between the absolute humidity of the air at a given temperature and the absolute humidity that would produce saturation at the same temperature.

The practical consequence of these temperature and humidity relations is that under interior conditions of high temperature and low relative humidity, the air tends to absorb moisture from everything it touches, wall-paper, furniture, carpets, clothes, books, food, and also from the human body. This drying process is not healthy for the material objects just mentioned and in most cases it is not healthy for human beings. When the air temperature is low, or its relative humidity high, and especially when these conditions are combined, there is much less tendency toward this absorption of moisture.

When air that has been under combined conditions of high temperature and high relative humidity, is cooled to any considerable extent, there results a condensation of its moisture content above that required for saturation at the lower temperature. The effects of such condensation, representing in the interior the exact duplication of an exterior fall of dew, are generally as unwelcome as the drying process above described. A pessimistic way to regard the humidification problem is as an attempt to strike an unhappy medium between the disadvantages of rapid evaporation on one hand and the equal disadvantages of excessive condensation on the other.

The rate of air change—that is, the amount of air to be treated—is another factor of importance in the humidification problem. When air change is rapid, large volumes of air require treatment and the problem is correspondingly large. But the fact of rapid change implies rapid air motion and the latter serves to increase the evaporation rate, if this flow of air can be directed over the surface of the water.

While a rapid change of air implies rapid air motion, a rapid air motion need not imply rapid change of air. Circulation of the air in a closed room will produce a similar increase in evaporation rate, if the flow of air is similarly directed over the surface of the water. In addition, such air movement will hasten the diffusion of the water vapor to all parts of the room.

All of the above factors, temperature, ventilation, and circulation, relate to air conditions.

From the angle of water conditions, humidification problem gains two more factors, those of exposed water area and of water temperature. The quantity of water supplied for humidifying purposes is strictly secondary in importance to the matter of exposed area of water surface. A given quantity of water presents the most exposed surface when all sides are exposed to the air (meaning, practically, when falling through the air) and when in a finely-divided state (since the ratio of surface to volume is that of square to cube, the division of a given volume into a certain number of similar smaller volumes results in the multiplication of exposed surface by the same number). The cloud condensed from a steam exhaust represents the finest division in which water vapor is visible, and it is easy to note how rapidly this cloud is dispelled (the water evaporated) under favorable atmospheric conditions.

When water is evaporated there is always an apparent disappearance of heat. This may be drawn from either the water, or the air, or both. If the air has to supply all or part of this heat, its temperature is reduced and it has less capacity for absorption at the lower temperature. So it is an aid to evaporation to heat the water and the nearer the water temperature approaches its steaming point (212° F. at normal atmospheric pressure) the easier it is to evaporate this water. One obvious way to secure both fine division and high temperature of the water is to supply it to the air in the form of steam and this method has been used to advantage in some cases.

TEMPERATURE RELATIONS OF ABSOLUTE AND RELATIVE HUMIDITY AT NORMAL ATMOSPHERIC PRESSURE, 14.7 LBS. PER SQ. IN.

Absolute Humidity in Pounds of Water per cu. ft. of Air.	Temperature degrees F.	Relative Humidity in per cent with 0.00049 lb. Water per cu. ft. Air
0.000031	—20	Precipitation
.000051	—10	"
.000079	zero	"
.000125	10	"
.000190	20	"
.000281	30	"
.000304	32	"
.00034	35	"
.00041	40	"
.00049	45	1.00
.00059	50	0.83
.00070	55	.70
.00082	60	.60
.00097	65	.50
.00114	70	.43
.00134	75	.37
.00156	80	.31
.00182	85	.27
.00212	90	.23
.00245	95	.20
.00283	100	.17
.00325	105	.15
.00373	110	.13
.00426	115	.11
.00488	120	.10
.00554	125	.09
.00630	130	.08

NOTE:—The absolute humidity assumed for column three corresponds to about ½ lb. of water per 1000 cu. ft. of air—approximate contents of a room 10 ft. x 12 ft. x 8 ft.—and produces a satisfactory relative humidity at a room temperature of 65° F.

(To Be Continued.)

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OZONE has had a curious history as far as its use in heating and ventilating work is concerned. That fact that it now bids fair to become an integral part of standard ventilating equipment lends fresh interest to its career which, up to a recent date, has been as changeable and unstable as ozone itself. The present generation can recall very well the original use of ozone for purifying and freshening indoor air. To go no further back than 1913, we have Franklin's authoritative exposition of the subject which appeared at the time in these columns. For awhile it seemed that ozone had "arrived" in ventilating circles but, as everybody knows, the agitation over its advantages subsided almost as quickly as it arose. It is telling no secret to say that many feared its practical effect on the ventilating industry as not only involving recirculation but possibly supplanting fans and blower systems; we had not then come to a full acceptance of the idea of air recirculation. The real cause, however, for its slow progress was a very definite impression that its long-continued use might have harmful effects on human health which might not be disclosed in the casual application of ozone as then practised.

So matters drifted along until 1920 when Hallett startled the engineering world with his account of the use of ozone in the St. Louis public schools and of the remarkable results which had followed in the way of fewer absences due to illness on the part of both school children and teachers, together with a marked fuel economy incidental to the recirculation of the air. If the Franklin exposition constituted a convincing theoretical justification for the use of ozone, the Hallett evidence was of equal importance in dealing with the practical aspects of its use.

In the meantime the soaring prices of fuel and the costliness of purely fresh-air circulation were having their effect not only on the scoffers but also on those who were frankly interested but not convinced. During this period the ozone advocates were not idle, but were busily perfecting their plans for the era they felt sure was coming.

This brings us to the Hill and Aeberly ozone tests, recently completed in Chicago and which are being reported in these columns. It is safe to say that no more disinterested experiments have thus far been conducted of the use of ozone and judging from their character and extent, as well as the established reputations of the investigators themselves, it would appear that the place of ozone in ventilating work is about to be definitely fixed.

A few months ago we were prompted by the rapid development in heating boiler design to say that as the boilers of former years looked out of place at the present time, so it might be expected that the designs of to-day would undergo much further development in the years to come. We feel that this applies with equal force to the whole field of mechanical heating and ventilation as now practised. On another page will be found a conception of the "air washer" of the future. Equally prophetic views might be presented dealing with the era of the "small unit," as distinguished from central fan blast systems. This does not mean that the central systems will not always have their place and usefulness but it would be idle not to recognize the rapidly-growing application, for certain classes of work, of the individual unit.

At one time it was thought that this development might have a disastrous effect on heating and ventilating engineering in reducing the science to a mere "rule of thumb." But the enineering talent now employed in the application of "unit" systems has served to dispel that fear, the net result being that the engineer has been given another tool to use in his practice.

As for the central fan blast system, one has only to note the development of the ejector principle in air circulation through ducts to see that fan blast heating is to have a greater field than ever before and one that can be carried into many new procesess, especially in connection with air conditioning, in a way that was not feasible with the older methods.

It is a remarkably healthy sign for the industry that such conditions prevail as are here outlined. It spells Progress in no uncertain terms and the kind of progress that means prosperity for all concerned in the years to come.

DEPARTING from our usual practice, the 1921 Index of THE HEATING AND VENTILATING MAGAZINE will appear as a supplement to the January number, instead of in this issue. This will permit a more accurate compilation of the contents of the 1921 volume and will also afford that much more space for the rapidly accumulating reading matter that is pressing for publication.

RESEARCH DEPARTMENT

This department is the natural outgrowth of the movement inaugurated a few months ago designed to give the readers of THE HEATING AND VENTILATING MAGAZINE a definite voice in the selection of articles and topics for discussion in these columns. In every case the items here presented are based directly upon suggestions received from our readers.

Steam Consumption for Car Heating.

QUESTION—How much steam is used by a standard passenger coach per hour when running; also when standing on a coach track and receiving its steam from a boiler plant? Give these amounts for northern lines, southern lines, eastern lines and western lines.

ANSWER—The accompanying curves, which are here first published, are offered as an answer to our correspondent's question. Curve A, as an average of several tests, shows the B. T. U. required for various temperature differences to heat wooden passenger coaches standing and running, while B shows similar and interesting results as compared with the heating per cubic foot of the Biltmore Hotel.

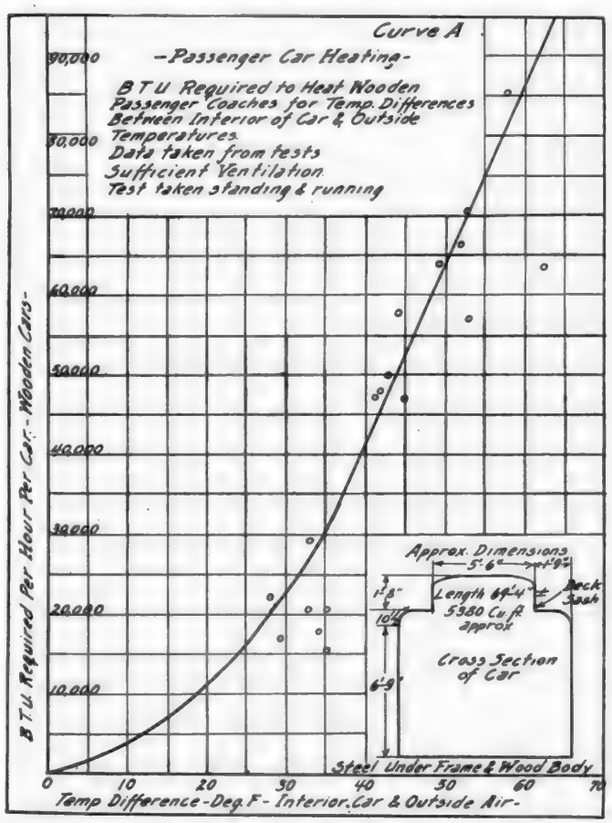
A summary (No. 1), is also given of the results obtained by a test made in Buffalo to determine the amount of steam required to heat a standard wood coach, standard steel coach and Pullman steel sleeping car.

The three cars in question were located on a siding in the yards and connected up with live steam supplied from a main laid specially for this test. Train line pipes for the three cars were blown out at same time; open end of the train line on each car shut off. The condensation from each car was drained into pails and weighed, the weight of condensation being taken from the time the supply valves were opened until the internal temperature was 70° F. and tabulated, and from 70° F. until the steam supply was cut off entirely. A uniform internal temperature of 70° F. was aimed at as near as possible by the regulation of the supply valves, all doors and ventilators being kept closed during the test. Train line and radiator pipes were tested for leakage. Steam pressure on main supply line 40 lbs.

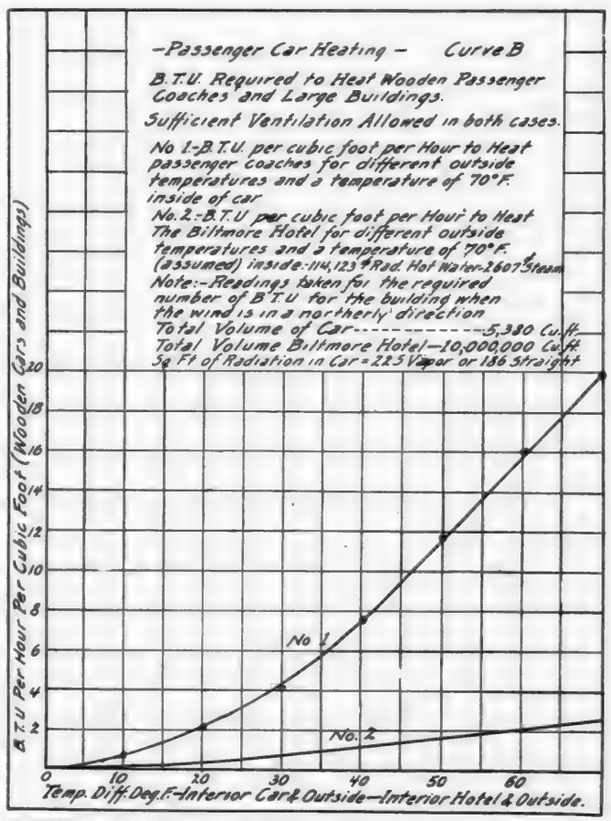
It will be noted from the data that the steel coach heated to a temperature of 70° F. much faster than either the wood coach or the Pullman steel sleeping car. This difference was practically due to the difference in the amount of radiation in each car. Comparing the efficiency of the steel coach and Pullman steel sleeping car with the wood coach, it required 237% more steam to heat the steel coach and 481% more steam to heat the Pullman steel sleeping car, or a ratio of 2.37 to 1 and 4.81 to 1, respectively.

Three eight hour tests were also made on four wooden day coaches while standing at North White Plains, N. Y., under conditions alternating from snow and sunshine and from high to moderate wind.

Each of the four cars under test had ten of the full size monitor ventilators fully upon. (Five on each side of the car). The ventilators on one side of the car were alternately opened and closed, the open ventilators on one side of the car being diagonally opposite those open on the other side of the care. This left ten full size ventilators closed on each car in addition to the two small ventilators at the ends.


Curve A
-Passenger Car Heating-
B T U Required to Heat Wooden Passenger Coaches for Temp. Differences Between Interior of Car & Outside Temperatures.
Data taken from tests
Sufficient Ventilation
Test taken standing & running
B T U Required Per Hour Per Car - Wooden Cars -
Approx. Dimensions
Length 64'4" 5380 Cu ft approx
Cross Section of Car
Steel Under Frame & Wood Body
Temp Difference - Deg F - Interior Car & Outside Air -

CURVE A—HEAT REQUIRED BY RAILWAY PASSENGER CARS.


-Passenger Car Heating - Curve B
B.T.U. Required to Heat Wooden Passenger Coaches and Large Buildings.
Sufficient Ventilation Allowed in both cases.
No 1-B.T.U. per cubic foot per Hour to Heat passenger Coaches for different outside temperatures and a temperature of 70°F. inside of car
No. 2.-B.T.U per cubic foot per Hour to Heat The Biltmore Hotel for different outside Temperatures and a temperature of 70°F. (assumed) inside: 114,123 ft Rad. Hot Water 2607 Steam
Note:-Readings taken for the required number of B.T.U for the building when the wind is in a northerly direction
Total Volume of Car ---------- 5,380 Cu ft.
Total Volume Biltmore Hotel - 10,000,000 Cu ft
Sq Ft of Radiation in Car = 225 Vapor or 186 Straight
No 1
No. 2
B.T.U Per Hour Per Cubic Foot (Wooden Cars and Buildings)
Temp. Diff. Deg F - Interior Car & Outside - Interior Hotel & Outside.

CURVE B—COMPARISON OF HEAT REQUIRED BY RAILWAY PASSENGER CARS AND BY LARGE HOTEL BUILDINGS.

SUMMARY No. 1

Steam Consumption From Tests on Car Heating

	Wood Coach	Steel Coach	Pullman Steel Sleeping car
Radiating surface, 1½-in. pipe in square feet	191	382	267.4
Exterior temperature at 10:00 A.M.—deg. F.—	26	26	26
Interior temperature before steam was applied..	43.5	40	37.5
Temperature raised to 70° F. in hours at.....	12:30 P.M. 2.5	11:30 A.M. 1.5	12:15 P.M. 2.25
Exterior temperature deg. F. at.....	12:30 P.M. 23	11:30 A.M. 24.5	12:15 P.M. 23.5
Steam consumed in raising temp. to 70° F. pounds	219	456	661
Temperature held 2 hrs. at 73° to 70° F. until	2:30 P.M.	1:30 P.M.	2:15 P.M.
Exterior temperature deg. F. at	2:30 P.M. 22.5	1:45 P.M. 22.5	2:15 P.M. 23
Steam disconnected at ...	2:30 P.M.	1:45 P.M.	2:15 P.M.
Steam consumed during the 2 hrs.—pounds...	63	*212.5	696.5
Total steam consumed in test—pounds.....	282	668.5	1357.5
Temperature drop after steam cut off, deg. F. in hours	10—2.5	22—3.25	15—2.75
Steam pressure at inlet —pounds	40	40	40
Exterior temperature at 5:00 P.M.—deg. F...	20	20	20

Date of test, Feb. 1, 1915

*2:25 hrs.—steam put on at 10:00 A. M.

The four cars were all coupled together with no other cars adjacent, thus leaving the south end of car 1783 and the north end of car 1781 with vestibule exposed to the outside weather. The vestibule doors (over the steps) were open on the north end of car 1794, and the west door on the south end of car 1763 was opened. All doors of the vestibule were closed where cars 1783 and 1784 were coupled, and likewise the doors where cars 1763 and 1781 were coupled. All doors leading from vestibules into cars were kept closed throughout all tests, and on all cars.

The average results of all these tests both for cars with and without thermostats, are given for one car in Summary No. 2, and it will be noted that the train line losses are separately recorded from the car losses.

SUMMARY No. 2

Average Results of all Tests

Tests have also been made by the Union Pacific Railroad on sample roof, floor and side wall construction of postal cars as used by different railroads with results in B. T. U. per square foot for twenty-four tests as follows:

Comparative Steam Consumption With and Without Thermostatic Temperature Control.

Cars with or without Thermostats	Air Temperature Deg. F. Exterior Temperature Deg. F.	Air Temperature Deg. F. In Cars	Air Temperature Deg. F. Difference	B. T. U. Total supplied to car	B. T. U. Discharged in condensation	B. T. U. Used in car for heating per deg. diff in temp. F.	Steam Pounds condensed per hour	Steam Pounds pressure
Without	34.23	87.58	58.35	81,674	10,932	1,346	70.45	66
With	34.23	66.96	32.73	23,153	2,550	643	19.93	66
Not including losses in train line which are							13.10	

SUMMARY No. 3

Data on Car Sections Included in Insulation Tests.

Road	B. T. U. per Sq. ft. per deg. F. of Temp. Diff. Per Hr. Section Side Wall	Roof	Floor
Union Pacific	0.2468	0.2399	0.2200
Wabash	.286	.2228	.2166
Northern Pacific	.4717	.405	.489
Frisco	.2387	.229	.335
Illinois Central	.4381	.459	.1736
Atlantic Coast L.	.257	.237	.242
Pennsylvania R. R.	.448	.4146	.245
B. & O.	.2425	.228	.210
Big Four	.258	.356	.236
Average	0.3208	0.3101	0.2625

Heat Transfer Through Tubular Heaters.

QUESTION—I should like information on the subject of heat transfer, using tubular air heaters with high-pressure steam, as for drying plants, etc.

ANSWER—If a return-tubular boiler be used as the heater, with steam inside the tubes and the air outside the tubes, the performance of the heater is the same as a blast coil heater under the same air velocity, when corrected for free area between the tubes or tube spacing, and tube dimensions. This is transverse air travel. The transmission per degree difference per square foot per hour will vary from 3 B. T. U. to 12 B. T. U., according to tube diameter, distance center to center, and velocity of air, also according to the hyperbolic mean T — t.

With the air passing through the tubes and the steam outside of same—longitudinal air flow—the transmission rate per degree difference per square foot per hour will vary from 1 B. T. U. to 6 or 7 B. T. U., according to the length of the tube in diameters, the diameter of the tubes and the hyperbolic mean T — t, and the velocity of the air.

In either arrangement the resistance is entirely on the air side; therefore, the transverse air flow (or air passing across the tubes with the steam inside the tubes) is more effective.—BURT S. HARRISON.

Hand Firing of Anthracite Coal in Low-Pressure Boilers.

QUESTION: I should like to obtain information on hand-firing of anthracite coal in low-pressure boilers. I am satisfied that the average janitor or fireman has no idea of the proper manner of firing. For instance, my janitor has been carrying a fuel bed of something like 12 in. I believe that 4 in. would give better results and be far more economical. I want, therefore, some information that will tell a janitor how he should use his coal and manipulate his drafts.—S. H. B.

ANSWER—Two bulletins have been published which deal with this subject as part of the problem of coal saving in heating houses. They are "Five Ways of Saving Fuel in Heating Houses," by Henry Kreisinger (1918), Technical paper No. 199, Bureau of Mines, Washington, D. C.; and "Coal Thrift," with suggestions for house heating, Bulletin of the Massachusetts Board of Education, Department of University Extension, Vol. III, No. 1, (January, 1918).

Both bulletins refer to the question mentioned. The first one recommends (Page 6) a fire depth of 5 in. to 10 in. The second advises keeping the fuel bed even with the five-door, with some ashes on the grate, which implies keeping the fire-pot nearly full of burning fuel (Page 8).—E. H. LOCKWOOD, assistant professor of mechanical engineering, Sheffield Scientific School, Yale University.

Formula for Proportioning Aspirating Radiators.

QUESTION—Give correct formulas for proportioning aspirating radiators in vent flues. Most of the data on this are scattered and vague. Where States have adopted ventilation laws, the rulings are very different. For example, Indiana states the minimum amount of radiation shall be 27 sq. ft. per stack, and Illinois requires at least 9 sq. ft. in aspirating radiators. We are faced with the design of heating systems in States which at present have no ventilation laws and a standard method of sizing aspirating radiators should certainly be adopted.

ANSWER—A formula for velocity of air in flues, published in my book of "Facts and Fancies" is as follows:

$$V = 240 \sqrt{h \frac{t_1 - t}{491.4}}$$

in which
h = height of flues in feet.
t_1 = internal absolute temperature,
t = external absolute temperature.

If a plenum is maintained in the building, probably all that is necessary would be to install sufficient heating surface in the vent flue to keep same at or above the normal building temperature.

The foregoing formula can be used in estimating the amount of heating surface required to give a definite temperature of air in the stack when the volume of air to be handled and size of the stack are known.—H. M. HART.

Use of Superheated Steam for Air Heating.

QUESTION—I should like to obtain some data on the use of superheated steam for air heating.

ANSWER—We presume the inquirer has in mind using superheated steam in a coil, for instance, over which the air to be heated is blown. If this is the inquiry we have the following to say:

Superheated steam, being practically a perfect gas, gives up its heat reluctantly; therefore, in a closed coil where a trap is provided to take off the water of condensation, the superheated steam will break down very slowly and the trap work seldom. Thus the total amount of heat given off by the coil in a given time will not be nearly as great as if the steam were saturated at the same pressure, although the heat that is given off will be at a higher temperature.

In other words, it may be said that it is the latent heat which does the work, and the superheat must all disappear before any latent heat is available so that superheating the steam really has the effect of retarding the operation.

On the other hand, if the coil should be left open to the atmosphere, all the latent heat would be lost and only a portion of the heat represented by the superheat in the steam would be doing work. This, of course, would be an impossible arrangement from a practical standpoint.

The best way to heat air is to heat it directly and we have built and are building air heaters for this purpose.—ALEXANDER BRADEEY, New York sales manager, Power Specialty Company.

Model Chimney Ordinance Promulgated by National Board of Fire Underwriters.

As we go to press the important announcement reaches us that the proposed model chimney ordinance which has been prepared by the National Board of Fire Underwriters, has now received the endorsement of no less than twelve of the organizations representing the interests affected, including the heating engineers' society, and has now been officially promulgated. It will appear in THE HEATING AND VENTILATING MAGAZINE for January.

CORRESPONDENCE

Heat Losses Through Terra Cotta and Tile Walls.

EDITOR HEATING AND VENTILATING MAGAZINE:

In looking over your Standard Data Sheets, I note from Data Sheets No. 1-A and 1-D that you claim that terra cotta or tile walls have a greater heat conductivity than solid brick walls. We have built a number of tile buildings and find actual conditions to be opposite from that given in your heating data pertaining to tile.

In an effort to verify our practical experience with actual test, the writer wrote the Denison Interlocking Tile Corporation, of Cleveland, O., for any data they had on the subject, and they replied giving the report of a test made by Professor Robert E. Snyder, of the Department of Physics, Case School of Applied Science, of Cleveland, which shows the following B. T. U. loss per square foot of wall surface per hour for one degree difference in temperature, covering an average to two tests of six and five-hour exposures, respectively:

13-in tile	1.105
13-in. brick	1.945
17.5-in tile	1.11
17.5-in. brick	1.71

While these figures do not in any way compare with those given in your heating data, they tend to prove that hollow tile is a better insulator than solid brick masonry.

Would appreciate your comments on the above.

F. B.

Chicago, Ill.

If our correspondent will compare the lower values for walls of tile, stucco and plaster, as contained in the Standard Data Sheets, with those of brick plastered on both sides, he will see that the Data Sheets do not disagree, but are in agreement with the correspondent's statement that hollow tile is a better insulator than solid brick masonry. When, however, it comes to a comparison of tile and stucco, with brick plastered inside, or plain tile with plain brick, it would seem that the conditions would be somewhat different. Thus doubtless some of the greater efficiency of tile is due to its protecting coat of plaster or stucco, effectively covering cracks at joints. When these coatings are not present, as would probably seldom, if ever, occur in practice, tile might be less efficient as a heat insulator than brick.

This statement is made in the absence of any known proof to the contrary, since, there was, and still is, very little information published on heat losses through brick when plastered on both sides, and much less on hollow tile, particularly for walls over 6 in. thick. For tile plastered on both sides, similar to the illustration shown on Data Sheet No. 1-M, the only other authority formerly obtainable was the University of Pennsylvania, but since that time a more recent work on "Heating and Ventilating" by Allen and Walker gives the same values for tile as THE HEATING AND VENTILATING MAGAZINE, not for one condition only, but for each of the three conditions previously mentioned herein.

To make this clearer, the correspondent is referred to Data Sheets Nos. 1-J, 1-K, 1-L and 1-M, giving heat losses quoted by various authorities, also Data Sheets Nos. 1-H and 1-I, giving an index of these authorities. In all these cases it will be found that the values given by THE HEATING AND VENTILATING MAGAZINE approximate those of most authorities, in particular the values used by the Department of Buildings of the University of Pennsylvania, which values, incidentally are an average of various authorities.

Unfortunately, the values given by the correspondent do not permit of much discussion, since it is not stated whether

the walls are plain brick and tile, or otherwise; but that they are in error is apparent. Certainly the loss through plain or plastered 13-in. brick, or even brick of only 4-in. thickness, cannot be about twice that of glass, as so indicated by the tests in the correspondent's letter.

These tests, if acceptable, show brick in a very unfavorable manner, so far as comparative heat losses with tile are concerned. However, this is contrary to all other tests made heretofore, the values being about four and seven times as great as the usual or even maximum values given for tile and brick, respectively, and, as will be noted, the heat loss through 17.5-in. tile is almost the same as that through 13-in. tile. Such tests, when at so great variance with published facts can hardly be accepted, even in a comparative sense, since they are as liable to error in this respect as in any other.

Leonard Hill's Comments on the Factoring of the Kata-Thermometer

EDITOR HEATING AND VENTILATING MAGAZINE:

In reference to the article by Mr. L. Greenburg in your October issue on the experimental error involved in the factoring of the kata-thermometer, may I point out, firstly, that the factor is determined by me in a closed double-walled chamber in which the air and walls are at the same temperature. The variability of the temperature and "kata" cooling times shown in Mr. Greenburg's groups of figures seem to show that the covered pail he used did not fulfil these conditions. The "kata" cooling times I obtain in my chamber agree far more closely than those obtained by Mr. Greenburg, for example.—

Temperature	Time
25.2° C.	156
25.3	156.6
25.3	156.4
25.4	157.0
25.4	158.0
25.4	158.0

Secondly, the putting of the two kata-thermometers in the enclosure together and the pulling of these out exert a disturbing influence. One kata-thermometer only should be introduced to fulfil the conditions.

My coworker, Miss Hargood Ash, has just obtained with the same kata-thermometer a factor of 453 at 2.0°C., 464 at 19.5°C., and 474 at 25.3°C; a factor difference of 21 for a difference of 23°C.—a much larger temperature range than Mr. Greenburg's. Such a factor difference is of no importance in determining cooling powers. She obtained considerable greater variations of the temperature of the enclosure, of cooling times and factor by pulling two kata-thermometers out of the chamber together.

LEONARD HILL.

London, England.

Heat Transmission Through Steel and Glass

EDITOR HEATING AND VENTILATING MAGAZINE:

I am enclosing herewith a piece of steel and cut showing the style of building where this is used for side-wall and roof construction. I wish you would advise me the number of B. T. U. transmitted per square foot of this material per degree difference per hour.

Also advise me the number of B. T. U. that would be lost through 1 sq. ft. of glass surface when glass is placed in steel sash, each light being properly fastened and puttied to frame.

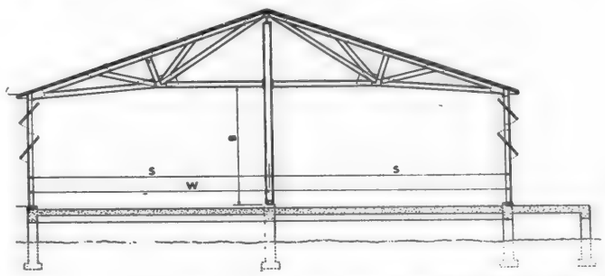
R. McK.

Jeannette, Pa.

The sample submitted by our correspondent for use in connection with an industrial building is about No. 18-gauge blue annealed steel for which the heat loss coefficient is not obtainable in the usual published data, except insofar as they relate to a lighter-gauge metal, such as sheet metal or sheet iron, in which cases the gauges are not mentioned. Under these circumstances, the manufacturers of this specimen (which is seldom used in building construction) is possibly the best authority to consult. However, the following data may be of help and a guide as to the probable losses, being, in any case, slightly greater than those for the sample submitted:

Average of two authorities giving the same coefficients for sheet iron walls, unlined, 1.20 B. T. U.

Average of six authorities, giving values from 1.26 to 1.3 B. T. U. mainly 1.3 B. T. U., for sheet metal roofs, unlined, 1.287 B. T. U.



TYPE OF BUILDING WITH SIDE WALL AND ROOF OF STEEL

Average of four authorities, giving values from 1.2 to 1.32 B. T. U. for sheet iron roofs on wood framing, 1.255 B. T. U.

Average of ten authorities on sheet metal and iron roofs, 1.274 B. T. U.

Average of twelve authorities on sheet metal and sheet iron roofs and walls, 1.262 B. T. U.

It should be noted that heat coefficients for corrugated iron are not given in the foregoing as such losses are much greater than those for sheet metal or sheet iron. (See Data Sheets Nos. 1-H, 1-I, 1-S and 1-ZZZ). Hubbard in "Power, Heating and Ventilation" says: "Tests show that the transmission losses through unlined corrugated metal are very nearly the same as for a single window, and for all practical purposes no distinction need be made between the walls, windows or roofs in building of this kind."

Harding and Willard, in "Heating and Ventilation" state:

"The temperature of the air in contact with the under side of a ceiling or roof is found to be higher than the temperature maintained at the breathing line, at which point the temperature is usually measured, due to the natural tendency of the warmer or less dense air to rise.

"It is recommended that an increase of approximately 15% be made to the specified inside temperature for the temperature at the ceiling for ceiling or wall heights not exceeding 15 ft., and 30% for ceiling heights of 20 ft. or more in estimating the heat loss of roofs. Thus, if 65° is the specified inside temperature to be maintained in a room, the height of which is 20 ft., the temperature of the air in contact with the under side of the roof may be assumed as 65° + 30%, or 85°."

As to heat losses through glass windows, these are covered in detail on Data Sheets Nos. 1-F, 1-I and 1-J, but for the immediate use of the correspondent it may be of help to state that the authorities quoted in the Data Sheets and many others, 32 in all, give values ranging from 0.96 to 1.35, of which one-third use 1.09 and one-fourth, 1.00, the average of all authorities being 1.05.

Both Professor J. D. Hoffman and the THE HEATING AND VENTILATING MAGAZINE recommend 1.00 as representing the nearest actual service conditions and a fair average of the values used by engineers in commercial practice to-day. This value was also accepted by the National District Heating

Association and it might be added that such a value has the advantage of being quickly applied.

The correspondent mentions that each glass is in steel sash, properly fastened and puttied. The method and care used in securing the glass, however, does not affect the heat loss through the glass itself, although it does vitally affect the allowance for infiltration based on window leakage, but this is a matter taken care of in the number of air changes.

In the construction described, there would doubtless be but very little leakage, particularly if properly maintained, a factor which, by the way, should be given due consideration as the building ages. Another point is that the principal source of leakage is around the perimeter of the windows, but with weather strips and some forms of metal sash, this may be effectively reduced. Much information is now available regarding the latter and the preventable leakage.

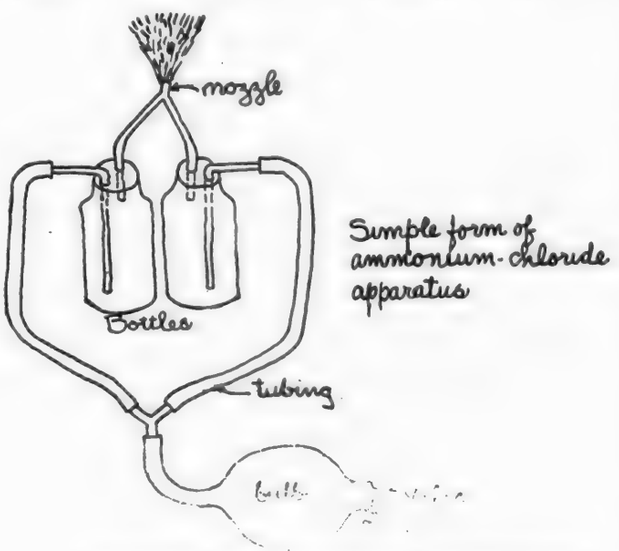
CHATS WITH UNCLE BEN

Smoke Bombs and Air Openings

SOME fellow asked me to put a piece in the paper telling, if I knew, something about ways of determining air currents in a room. He had some vague notion, I guess, that he could buy one of these here bombs that would maybe blow up into stars which would spell out the results like Fourth of July fireworks.

"Anyhow, you can tell him that so far as I can see from my own experience, the least objectionable draft detector, and the most satisfactory, is a few sticks of Chinse punk or incense. You can see which way the wind blows, and how fast, and neither you nor the occupants will need gas masks. Myself, I have had pretty good luck in several important cases with some very fine silk ravelings on the end of a stick. They give what my friend, the Doc, calls, an elegant demonstration."

"For a real showy test, a rubber bulb with a valve, such as is used for taking air samples can be rigged up to blow air simultaneously or at the same time through two bottles. The bottles may be hip bottles or, say, half that big. You put ammonium hydroxid in one bottle and hydrochloric acid in the other bottle. Action on the part of the squeezer will eventuate in a dense white cloud of ammonium chloride. This does not settle quickly out of the air, is not particularly horrible as to odor, and is a fine visualizer. I heard two chemists scrap off and on all winter as to what we had any right to call this white stuff, and I conclude that we have no right to call it a gas, and certainly no right to call it smoke, and it isn't vapor, so I just recommend that we call it ammonium chloride, which is what it is!"

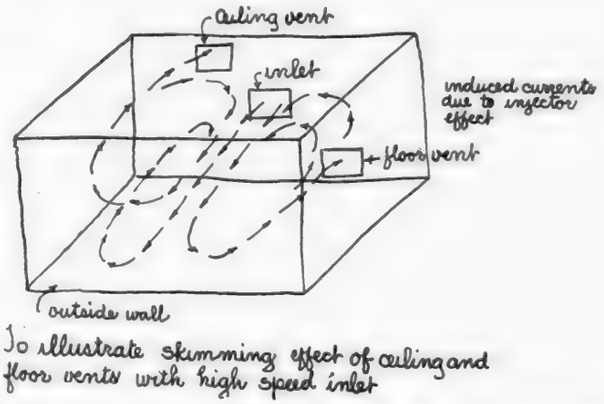


APPARATUS FOR DETERMINING AIR CURRENTS.

Here is a sketch of the mechanism, made with Uncle Ben's good left hand.

"Some other patriot desires that I expound a little on 'arguments for and against the inlet at the bottom, and vent at the top, in systems of mechanical ventilation.'

"I maintain that there are no arguments required. What is needed here is intelligence. If we are endeavoring to cool a room, vents at the top during such an attempt will prove to be willing little helpers. If we have a large office, for instance, and have trouble to keep the vents at the floor un-bedammed with pasteboard, old hats, furniture, etc., because the fair occupants who sit near cannot endure drafts, then auxiliary vents at the ceiling will be of great advantage. This will be because they will permit an air change, while reducing the velocity of the floor currents. Ceiling, vents or side wall vents adjacent to inlets which have a high velocity are indeed fortunately located, for due to the injector effect they can skim off the worst of the vitated air. Here—I'll make you a sketch and show you what I mean.


ceiling vent
inlet
induced currents due to injector effect
floor vent
outside wall
To illustrate skimming effect of ceiling and floor vents with high speed inlet

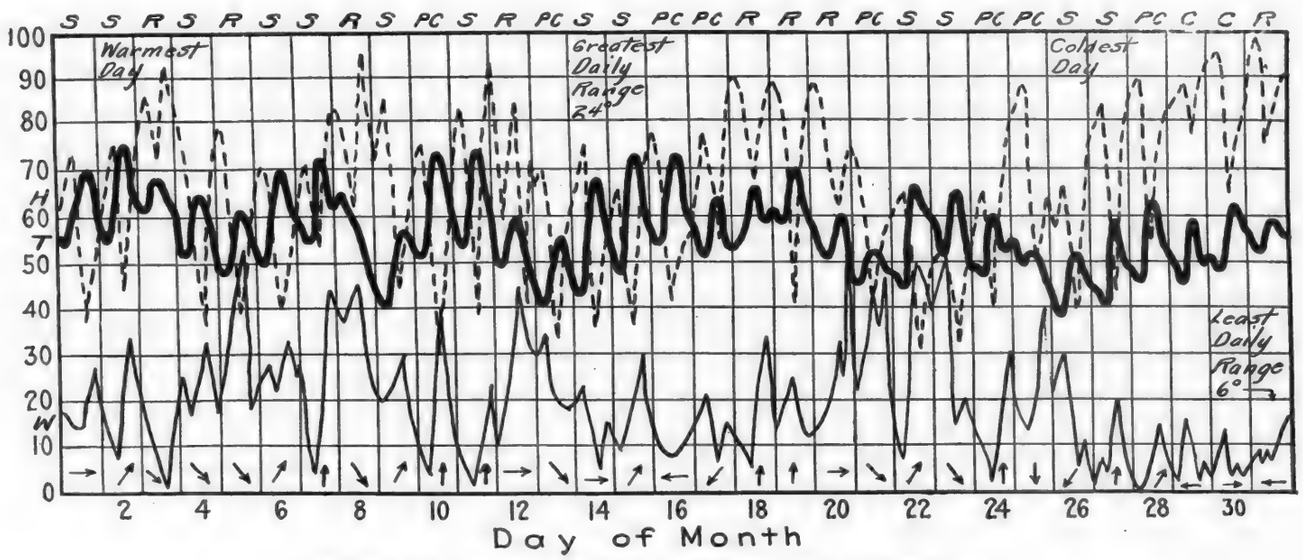
EFFECT OF HIGH VELOCITY OF AIR ON DISTRIBUTION.

"If the entering air can be brought in in a perfectly uniform and thoroughly distributed current through the floor of a room, we can do away with any ceiling or roof, and can forget heat losses through glass and walls, except as expressed in the making comfortable of the rising air. I have plenty of churches and theatres where results are eminently pleasing, using inlets in the floor and outlets in the ceiling. I don't recognize any argument against it, in fact it's about the only way that will work in a big auditorium, provided, of course, that you have automatic temperature regulation. After all, unless you have this, you'd better use stoves. With any system of cooling in a large auditorium it is unwise to blow in any more air at any given time than is proportional to the number of occupants at that time. If, for instance, in a big theatre the back half of the balcony is empty and the general air temperature of admission has to be 60° to suit conditions in the occupied zone—well, beware, my boy, of the little rivulets of cold air from the unoccupied zone falling like water to impinge on the bald heads and powdered necks of the people. You can't make cool air rise through hot air or stay on top of hot air, and this simple little fact wrecks many a budding career, and hangs on as a true principle whether the inlets are at the floor or at the ceiling.

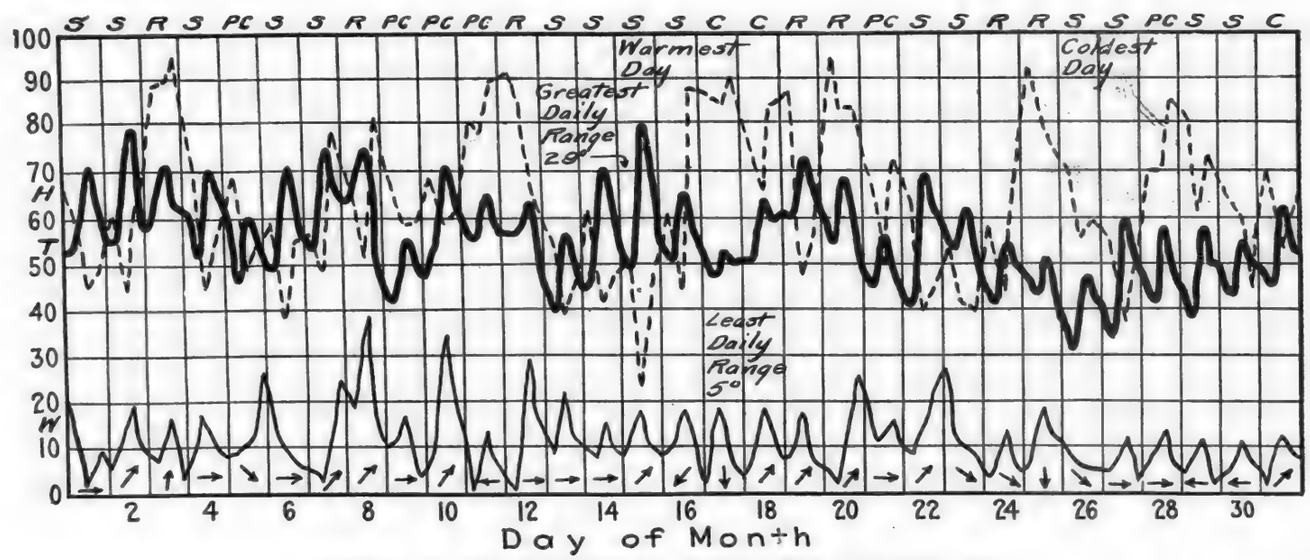
"I will have to have local and, as it were microscopic, facts to expound more particularly on this subject, so I have merely touched the high places. If my interested friend will particularize, so will I."

THE WEATHER FOR OCTOBER, 1921

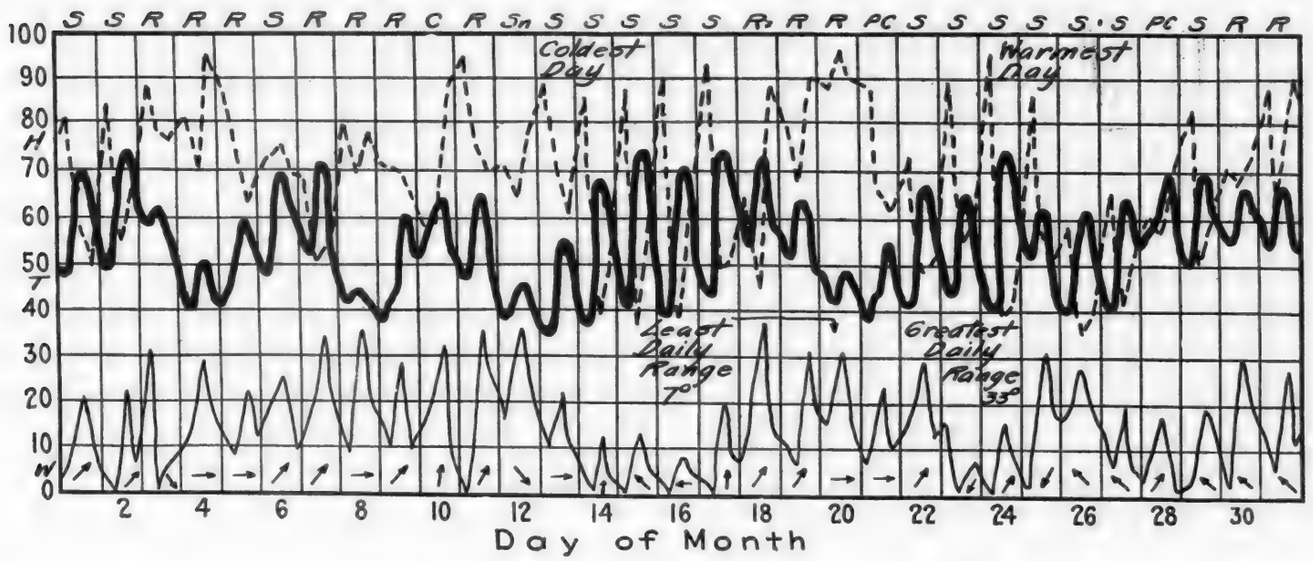
	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, degrees F.	74	79	74	79	83
Date of highest temperature	2	15	24	17	24
Lowest temperature, degrees F.	38	31	35	36	38
Date of lowest temperature	26	26	13	8	8
Greatest daily range, degrees F.	24	29	33	23	28
Date of greatest daily range	14	15	24	5	24
Least daily range, degrees F.	6	5	7	3	6
Date of least daily range	31	17	20	30	30
Mean temp. for month, degrees F.	56.2	55.2	54.0	54.8	59.6
Normal mean temp. for month, degrees F.	55.6	52.3	54.9	53.2	58.4
Total rainfall, in.	0.74	1.24	2.25	3.26	1.45
Total snowfall, in.	none	none	none	none	none
Normal precipitation this month, in.	3.71	3.86	2.36	2.55	2.41
Total wind movement, miles	12318	7518	8843	10449	10518
Prevailing direction of wind	S.	W.	S. W.	S. W.	S.
Number of clear days	9	12	12	14	15
Number of partly cloudy days	16	12	5	10	9
Number of days on which rain fell	8	7	13	15	9
Number of days on which snow fell	none	none	1	1	none
Snow on ground at end of month, in.	none	none	none	none	none



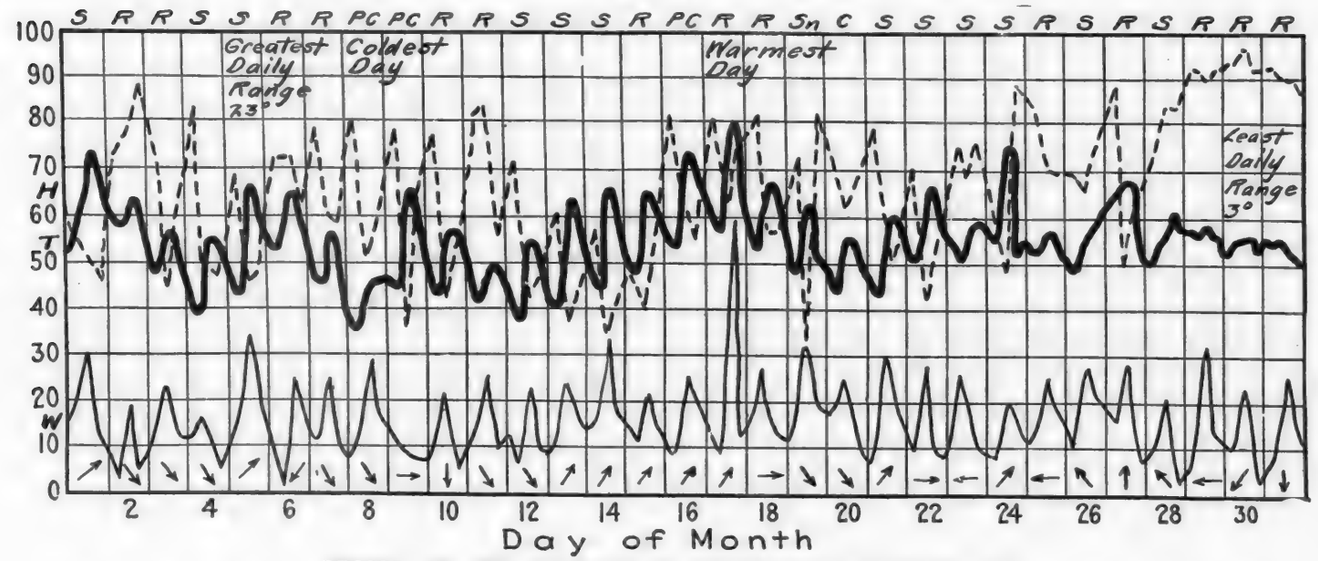
RECORD OF THE WEATHER IN NEW YORK FOR OCTOBER, 1921.
(Hourly Observations of Relative Humidity Plotted on this Chart).



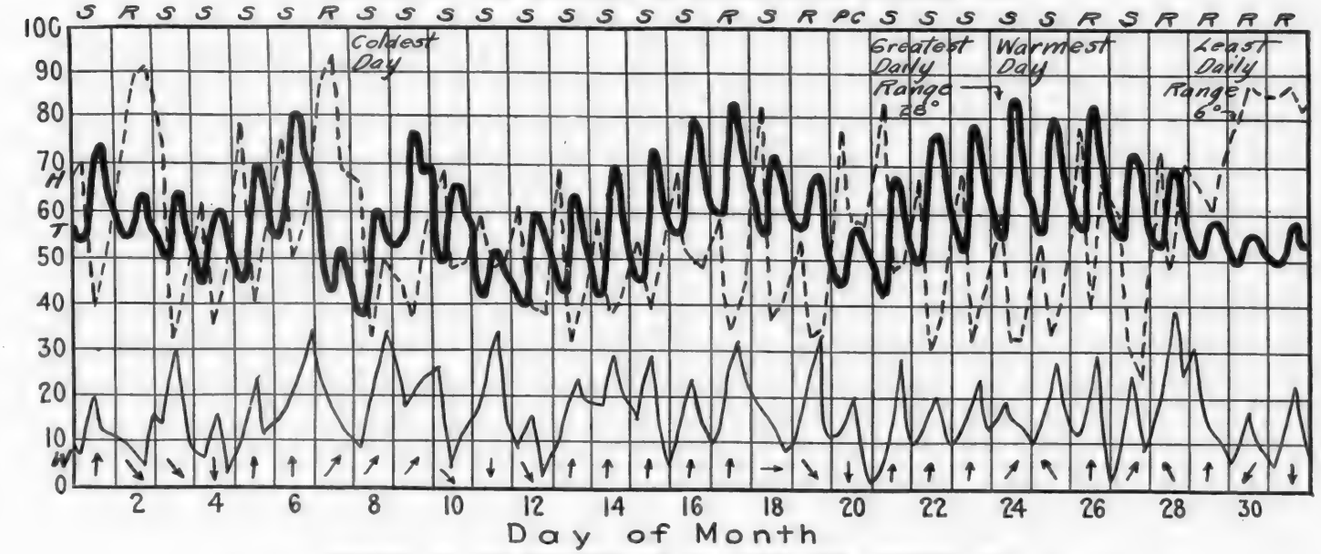
RECORD OF THE WEATHER IN BOSTON FOR OCTOBER, 1921.



RECORD OF THE WEATHER IN PITTSBURGH FOR OCTOBER, 1921.



RECORD OF THE WEATHER IN CHICAGO FOR OCTOBER, 1921.



RECORD OF THE WEATHER IN ST. LOUIS FOR OCTOBER, 1921.

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United State Weather Bureau.
Heavy lines indicate temperature in degrees F.
Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings taken at 8 A. M., 12 M., and 8 P. M.
S—Clear, P C—partly cloudy, C—cloudy, R—rain, Sn—snow.
Arrows fly with prevailing directions of wind.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

Arrangements for Annual Meeting.

One of the noteworthy features of the forthcoming annual meeting of the American Society of Heating and Ventilating Engineers, to be held in New York, January 24-26, 1922, will be the location of headquarters in the Hotel Pennsylvania, Seventh Avenue and 33rd Street. Here will be held all of the sessions, both professional and social.

The programme for the meeting provides for five professional sessions, devoted respectively to heating, ventilation, research and drying. The society's annual dinner is scheduled for the evening of January 26 in the grand ball room of the Hotel Pennsylvania.

Following the custom of former years, the New York Chapter will act as the host for the meeting and the entertainment features will be carried out by a committee headed by Secretary J. E. Bolling of the New York Chapter and composed of the chapter's entire board of governors. R. W. Pryor, Jr., will head the sub-committee on dinner arrangements.

Nominations for Officers for 1922.

Nominees for office in the American Society of Heating and Ventilating Engineers for 1922 have been announced as follows by the society's nominating committee:

For president, Jay R. McColl, Detroit; for first vice-president, H. P. Gant, Philadelphia; for second vice-president, S. E. Dibble, Pittsburgh; for treasurer, Homer Addams, New York; for members of the council: Homer Addams, New York; Joseph A. Cutler, Chicago; Samuel E. Dibble, Pittsburgh; William H. Driscoll, Long Island City; H. P. Gant, Philadelphia; E. S. Hallett, St. Louis; H. J. Meyer, Minneapolis; L. A. Harding, Buffalo; E. E. McNair, Detroit; and Perry West., New York

Nominations for members of the society's Committee on Research which has charge of the Research Laboratory in Pittsburgh are as follows, all being renominations: H. M. Hart, J. D. Hoffman, J. I. Lyle, W. S. Timmis and Perry West.

Solid Fuels Discussed by New York Chapter.

Before a large gathering of members of the New York Chapter, at its November meeting, November 21, in the Building Trades Club, "Solid Fuels," including both soft and hard coal, were discussed. The developments in the burning of soft coal without smoke were described by William A. Pittsford, a former smoke inspector of Chicago and now combustion engineer for the Kewanee Boiler Company. Mr. Pittsford's talk was illustrated by lantern slides and offered many suggestions in the way of practical suggestions for designing and operating boiler plants.

The other speaker of the evening was P. J. Dougherty, engineer for the International Heater Co., Utica, N. Y., who spoke on "The Use of Anthracite Coal and Coke in Domestic Heating." Mr. Dougherty's talk dealt largely with methods of firing house-heating boilers.

In opening the meeting, President A. S. Armagnac called for a report from Secretary J. E. Bolling, who stated that since the October meeting seventeen new members had been added to the roll. Charles V. Haynes, of Philadelphia, told of the completion of the plans for the erection of the memorial tablet to the memory of the late Director John R. Allen of the society's Research Laboratory, and in response to his appeal, further contributions in the amount of about $40.00 were subscribed.

Secretary C. W. Obert of the society gave an outline of the plans of the society's forthcoming annual meeting at the Hotel Pennsylvania, New York, at which the New York Chapter will act as host.

The meeting was then turned over to the special chairman of the evening, P. J. Dougherty.

Industrial Standardization in Germany

Much has been said in recent months of the way in which German industries are standardizing their products and of the need of America's waking up to its own opportunities in this respect. It is now possible to give an authoritative summary of the situation, based on the researches of the American Engineering Standards Committee. In a recent report the committee states that not sufficient attention has been given to the role which standardization is playing in German industrial reconstruction and adds, "the German industries are planning and are carrying through a far-reaching program of standardization as a necessary step in building up an unprecedented industrial structure which must rest in large measure on an extensive foreign trade. In no other country except Great Britain is standardization work being carried on upon a scale, or with an intensity, comparable with that in Germany."

The report states that since the close of the war, the central German standards organization, which was formed at that time under the title of the Normenausschuss der Deutschen Industrie, has put out 144 approved standard sheets, while 500 other sheets have been developed in tentative form.

The standards are issued under the general designation of German Industrial Standards (Deutsche Industrie Normen) usually contracted to the slogan, "Dinorm." The sheets are published in loose form.

Proposals for new subjects for standardization must come from some responsible body. The industry concerned is consulted, generally by a conference of the various organizations interested, to determine whether it is the consenses of opinion that the work should go forward. In case it is decided to undertake the work, the conference designates the chairman of the working committee.

The central office digests the information available on the subject for the use of the working committee. When agreement is reached in the committee on the draft of a standard it goes to the central office for editorial work. There it is scrutinized to see whether it is consistent with other standards; whether points have been included which concern other working committees; whether the drawings and nomenclature are in approved form, etc. After this editorial checking the central office has the draft of the standard put into proof form. It is then reviewed by an official clearing house committee, which contains a representative from each major line of work being carried on by working committees. If any change in substance has been made, it goes back to the working committee. If no such change has been made, it is published in the Mitteilungen, the official publication of the Normenausschuss, as a tentative proposal. Upon recommendation of the working committee, the standard is mailed to the members of the executive committee with a supporting statement. With their approval it is then republished as an official proposal. Six weeks are allowed for criticism when a standard is finally published unless additional important criticisms are received.

The foregoing refers to the work of the central body only, which is limited to subjects common to two or more industries. In addition there are some fifteen organizations known as special industry committees, each of which deals with the standardization work peculiar to a single industry, such as shipbuilding, electrical, agricultural, automotive, elevator, locomotive, paper, textile, and woodworking.

These committees are closely affiliated with, but not strictly an organic part of, the central body. They are organized not by the Normenausschuss, but by one or more technical or trade associations concerned with the particular subject in hand. Standards formulated by the special industry committees are published by the organization responsible. In most cases the final standards are published in loose-leaf form modeled closely after that of the standards issued by the Normenausschuss itself. These standards are submitted to the Normenausschuss before publication, in order to keep them consistent with the regular series of German industrial standards.

The volume of work being carried out through these special industry committees appears to be at least as great as that under the direct control of the central body.

BUREAU OF MINES EXPERIMENTAL TUNNEL FOR STUDYING THE REMOVAL OF AUTOMOTIVE EXHAUST GAS*

BY A. C. FIELDNER** AND J. W. PAUL***

In co-operation with the New York and New Jersey State Bridge and Tunnel Commissions, the Bureau of Mines has just completed the construction of an experimental tunnel in the Bureau's experimental mine at Bruceton, Pa., near Pittsburgh, Pa. The purpose of this tunnel is to make a final study of the ventilation problems arising in the adaquate ventilation of vehicular tunnels for automobiles and trucks, especially the 9000-ft. tubes that are being designed to handle the traffic between New York City and New Jersey under the Hudson River.

Chief Engineer Clifford M. Holland, of the Tunnel Commission has shown that there are three principal problems involved in planning the ventillation of this tunnel, namely— (1) The amount and composition of exhaust gases from motor vehicles; (2) The dilution necessary to render these exhaust gases harmless; (3) Determination of coefficients of air flow and horse-power required in ducts, bends and openings.

COMPOSITION OF AUTOMOBILE EXHAUST GASES.

The answer to the first problem was obtained by making road tests on 101 automobiles and trucks at the Pittsburgh experimental station. These machines were taken from service without any previous adjustment so that the composition and amount of the exhaust gas may be taken as representative of actual operating conditions prevailing in the tunnel. A report covering the results of these tests was submitted to the chief engineer of the Tunnel Commissions, on November 1, 1920, and will be published in the report of the commissions. Several papers have also been published in the technical journals summarizing the important results as regards tunnel ventilation and also with reference to gasoline losses in present day motor car operation due to the general use of unnecessarily rich mixtures.

In brief, the results of the road tests showed that the percentage of carbon monoxide (the poisonous constituent of automobile exhaust gases) for the various individual cars varied from 0.5% to 14%; passenger cars and speed trucks on level grades at 15 and 20 miles per hour averaged 7%, and 1-½ to 5-ton trucks at 10 miles per hour averaged 7.3% carbon monoxide.

DILUTION NECESSARY TO RENDER THE GASES HARMLESS.

The information obtained in the solution of problem 1, in connection with a traffic count of the motor cars that will use the tunnel, enabled the tunnel engineers to calculate the total quantity of exhaust gas that would be evolved in the tunnel. Before calculation could be made on the amount of air that must be used in adequate ventilation, it was necessary to determine the largest proportion of the exhaust gases (more especially carbon monoxide) in air that a man can breathe without any harmful effect whatever. A large amount of experimental work was carried on with actual tests—first on animals and then on men—at the physiological laboratory of Yale University, New Haven, Conn., under the direction of Dr. Yandell Henderson, consulting physiologist of the Bureau of Mines. It was found that when exhaust gases are diluted with fresh air to the point where the concentration of carbon monoxide does not exceed 4 parts in 10,000 parts of air, there is no noticeable harmful effect with exposures up to one hour. This result agrees with practical experience of Bureau of Mines engineers with regard to the effect of carbon monoxide in mine gases, and around blast furnaces and gas producers.

DETERMINATION OF COEFFICIENTS OF AIR FLOW AND HORSEPOWER REQUIRED IN DUCTS, BENDS AND OPENINGS.

After the first two problems with reference to the amount of carbon monoxide given off by motor vehicles and the allowable concentration had been solved, further investigations were required in determining the best method of supplying the requisite amount of fresh air which depends largely on the determination of certain factors with reference to the flow of air in ducts, bends and openings such as may be used in the tunnel. This problem is being investigated at the engineering experiment station at the University of Illinois at Urbana, Illinois, in cooperation with the engineering staff of the Tunnel Commissions and the Bureau of Mines. A half-size experimental duct 300 ft. long has been constructed; also full-size elbows of several patterns. Much data on coefficient of air flow, useful not only for tunnel ventilation, but particularly in the metal-mining industry, has been obtained.

A. C. Willard, head of the department of mechanical engineering and professor of heating and ventilating engineering, also consulting engineer for the Tunnel Commissions and the Bureau of Mines, is in charge of this work, which was carried out in accordance with the plans of Clifford M. Holland, chief engineer of the Hudson River tunnel project.

EXPERIMENTAL TUNNEL INVESTIGATION, PITTSBURGH EXPERIMENT STATION.

The final check on the solution of the three previous problems is to be obtained in the experimental tunnel that has been built in the experimental mine of the Bureau of Mines at Bruceton, Pa., just outside of Pittsburgh. An oval tunnel, or rather an underground oval track, having similar construction of ducts to those proposed in the Hudson River Tunnel, and an axial length of 400 ft, has been constructed underground. The cross-section is approximately 9 ft. wide and 8 ft. high. Above the ceiling of the tunnel is an air duct 3 ft. high, and below the floor is another air duct 2½ ft. high. Either duct may be used for introducing fresh air or for exhausting the contaminated air. The tunnel cross-section is sufficiently large to accommodate the smaller types of 5-passenger cars.

The tunnel is completely equipped with sensitive apparatus for measuring the temperature, humidity, quantity, velocity, and pressure of the air in various parts of the tunnel. A total of 48 air-sampling tubes are installed on eight cross-sections of the tunnel in order to obtain samples for chemical analysis, for determining the diffusion and concentration of the exhaust gases in various parts of the tunnel with different methods of ventilation.

An important feature of the experimental tunnel tests will be the comprehensive physiological and psychological observation to be made on the effects of temperature, humidity, rate of air flow, smoke and exhaust gases on the men driving the test cars.

In the tests, ten cars will be spaced at 40-ft. intervals and will be running at the rate of 10 miles an hour. 21,000 cu. ft. of air per minute, or sufficient to maintain a concentration of four parts carbon monoxide per 10,000 parts of air by volume, will be passed across the tunnel. Each driver and observer in the tunnel will be subjected to examination before and after tests by the physicians and physiologists in charge of this part of the work. The amount of carbon monoxide absorbed by each person during the tests will be determined by examination of a few drops of blood drawn immediately after the tests. Especially sensitive methods for making these blood examinations have been developed by the Bureau of Mines. The effect of smoke and temperature on the motor-car drivers are also important considerations.

It is believed that this underground tunnel in the experimental mine has important advantages over any above ground model, in that it more nearly represents actual conditions that will prevail in the proposed vehicular tunnel under the Hudson River. Situated as it is, about 130 ft. below the surface of the ground and 1050 ft. in from the pit mouth of the mine, it will have a constant temperature and be free from the wide temperature fluctuations and unavoidable leakages of air in an above ground model. The ground temperature surrounding the tunnel is nearly the same as that underneath the Hudson River. Means are installed for heating and humidifying the air to any of the conditions that may occur on the hottest summer day.

SUMMARY OF STUDIES TO BE CONDUCTED.

In conclusion, the studies to be conducted in the experimental tunnel are briefly summarized as follows: (1) The diffusion of exhaust gases in the cross-section of the tunnel by transverse ventilation, bottom to top, and top to bot-

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** Superintendent, Pittsburgh Experiment Station, U. S. Bureau of Mines.

*** Chief coal mining engineer, Pittsburgh Experiment Station, U. S. Bureau of Mines.

tom; (2) temperature and smoke conditions as affected by the operation of motor cars; (3) physiological and psychological effects of temperatures, exhaust gases and smoke under operating conditions; (4) final check on all previous investigations, and practical demonstration of the solution of the problem of ventilating tunnels traversed by motor vehicles.

ADVENTURES OF A BREATH OF AIR IN A MODERN HEATING AND VENTILATING INSTALLATION

By DAVID DARRIN

Air, as we know, has a peculiar instinct which may best be described as on overwhelming desire to be on the opposite side of a closed door. The particular breeze that we are about to join has been spending its morning darting thither and yon, say, among the chimney pots of Pittsburgh. Playing around with these dusky companions the little breeze, once pure, has picked up a good deal that is taboo in the best society.

Like all dirty-faced urchins, this breeze is very fond of candy and has been drawn from its romping by the smell of a candy factory. When it comes to candy, its motto is "All for one" and the breeze circled the factory looking for a conveniently open door or window. Seeing none, its interest centered upon a rectangular opening in one of the walls, provided with down-sloping, shutter-like baffles which serve to keep out the rain and some of the birds, but merely pique the curiosity of the breeze. Without knowing or perhaps even caring that this is a louvre, the breeze passed through in its reaction to that primitive instinct. Then its troubles began.

The next thing this breeze knew it was lost in a maze of pipes. The path was dusty and arid and by the time it emerged on the other side of the forest the breeze was hot and dry, all out of sorts, as a result of its contact with the tempering coils. Imagine then its disgust as it viewed just ahead, another barrier that looked like a louvre with its shutters in wrong. Seeking escape from its predicament the breeze rushed through this diffuser only to find itself face to face with the heaviest rain storm it had ever encountered.

In the twinkling of an eye the little breeze was drenched but after that first plunge, it rather enjoyed the bath and even started to look around for the rainbow. But there was none and just as well too, maybe, because this breeze would have been greatly shocked if it had seen what the shower did to its complexion. However, in place of the complexion lost in the mist chamber, the breeze had picked up enough moisture to put the pro back into prohibition.

Just as it was getting ready to sigh for a bath towel, the breeze looked up to find itself face to face with a third louvre-like obstacle in which the shutters slanted both ways and ran up and down instead of sidewise. Thinking of the old saying, "Three times and out," the breeze dived into this contraption and, while it entered to scoff, it emerged to praise the bath-towel effect of the eliminator. Feeling cool and lively, now, the breeze entered without hesitation upon the solution of another maze of pipes. This path was also a warm one, but the breeze was in better condition for it came through in good shape, only wishing that it had a fan. Hardly had the thought been formed, when the breeze found itself diving into what looked like a blank wall with a round spike sticking out from it. The breeze thought that it had now come to the end of its journey, with no chance for escape when suddenly the walls of its prison seemed to go bolshevik, whirling around like mad. The breeze felt itself grabbed by the scruff of the neck and bounced against one of the flying walls. The wall struck it a glancing blow and threw it out into a long dark passage, the spookiest it had ever encountered, and, as it started along this last lap of its path to liberty, the little breeze felt as if it had been well fanned and was sorry that it had come.

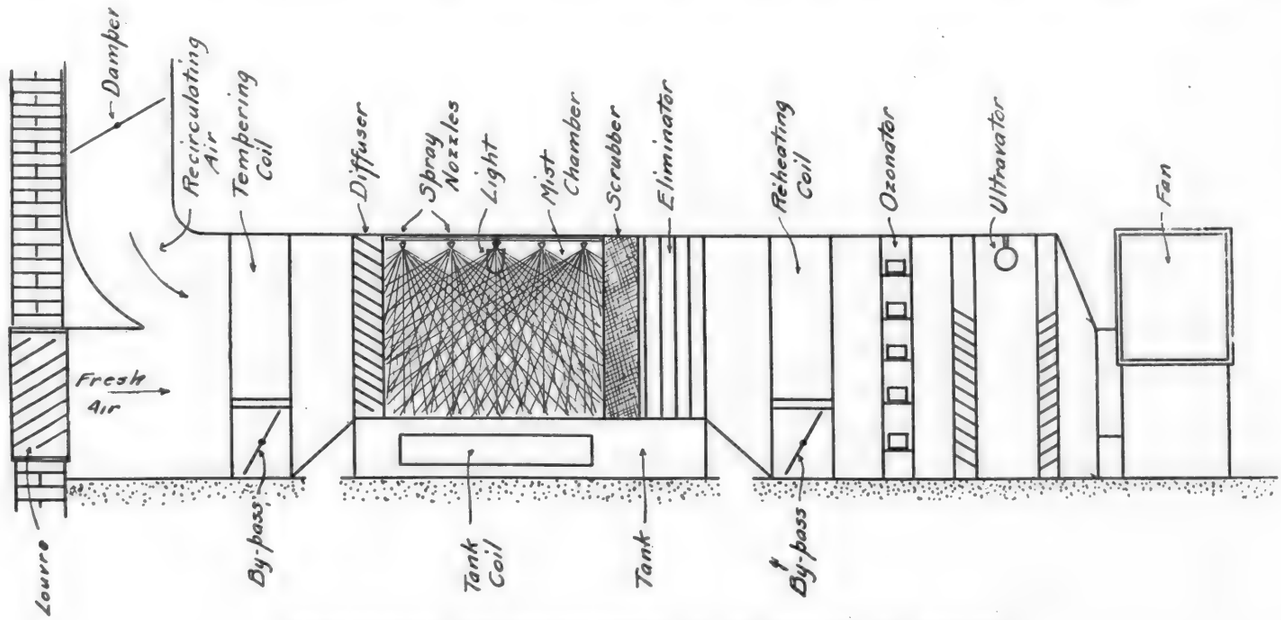
MIXING REALISM WITH ROMANCE

But the process which has proved such an exciting experience for this breath of air, is an old story for the spray nozzles and the washing water, the circulating pump and the fan. These are the drudges who must stay with the process day after day, year after year, and who may not even allow familiarity to breed contempt.

The tempering and the reheating coils must be adjusted to suit the temperatures of incoming and outgoing air. The circulating system must first take the dirt out of the air and then take it out of the water, so that neither the pump nor the spraying nozzles shall become clogged with it. The eliminators must take all of the superfluous water out of the air, so that it may not be damp enough to deposit dew in the rooms to which the fan must drive it. All must work in harmony and continuously, so that the air supply shall not only be pure and of the right temperature and humidity, but also constant in amount.

PREDICTING A NEW ADVENTURE

Wonderful as this process may seem in methods and results, the mistake must not be made of assuming that it has reached perfection. Nothing ever reaches perfection. The air benefits greatly by its intimate contact with water in its stormy voyage through the air washer, but sometimes it retains gaseous impurities which are not soluble in the water. When it is going through Nature's own air washing process, this difficulty is



DIAGRAMMATIC ELEVATION OF THE AIR WASHER OF THE FUTURE.

remedied by making the storm electrical and it seems reasonable to suppose that the artificial duplicate of this process will come eventually to the same means.

Indeed, the apparatus for this electrification has been long known and its application, separate from the air washer, has reached a commercial scale in what is called the ozonator. And the time is fast approaching when air conditioning will be more a necessity and less a luxury for all kinds of structures where people have to live and breathe.

For human use, air should be free from gaseous impurities and in the air washer of the future, our breath of air will meet a new terror between its exit from the reheating coil and its entry into the fan intake, a glowing thing shooting tongues of flameless fire that burn out of the breeze the last traces of its former disreputable associations.

NATIONAL TRADE EXTENSION BUREAU

Advertising Campaign Prepared for California Heating Contractors

In response to the request of the Heating and Ventilating Contractors' Association of Alameda and Contra Costa Counties, California, for suggestions for a consistent advertising campaign which the association was planning to launch, the National Trade Extension Bureau has prepared a series of nine initial advertisements, including copy text, art work and complete layouts, the first one of which appeared in the *Oakland Tribune* for October 15. The bureau announces that the same series of nine advertisements are available for use (copy, cuts, etc., to be supplied by T. E. B.) to every association and to every individual heating and plumbing contractor in the United States and Canada. Mats and stereotypes of all cuts included in this series are furnished free of charge to such associations or contractors. It is also announced that additional advertisements of the same nature will be offered to the trade as fast as they are prepared by the bureau.

T. E. B. Sales Promotion Program for 1922.

In connection with a conference of advertising and sales managers of members of the National Trade Extension Bureau, held at the bureau's headquarters, in Evansville, Ind., October 31-November 1, the following program of special sales promotion effort on the part of the bureau for 1922 was adopted:

January and February will be devoted to a campaign of an educational nature intended to promote better relations between the public and the heating and plumbing contractors. This will include the use of newspaper advertising copy and editorial matter, to be used by individuals, groups and associations. The contractors will be shown the importance of making their places of business attractive in appearance, and suggestions will be given for effective show-window and store displays, newspaper, car card and billboard advertising. Contractors will also be urged to make use of the "Premise Report Card" and the bureau's suggestions for "Compiling a Mailing List," and, in every way, properly organizing the sales work of their stores and offices with reference to the year's campaign. All of the foregoing activities will be supported by efforts directed to the manufacturer and jobber to secure effective co-operation from them through their organizations for the benefit of the campaign.

March will be used for a "Heat by Radiators" campaign.

April will be used for a "Bath in Every Home" campaign.

May will see a campaign for "Hot Water for Every Need."

June carries a campaign for "A Bath a Day."

August will bring a campaign for "Running Water on the Farm."

September a "Heat Regulation" campaign will be staged.

October will be devoted to a campaign on "Vacuum Cleaners," with special stress on the advantages of built-in equipment.

December will be used for a campaign on "Domestic Appliances."

National Trade Extension Bureau Inaugurates "Help Wanted" Campaign.

In addition to the eleven plans submitted by the President's Conference Committee on Unemployment as means for creating employment, the National Trade Extension Bureau suggests a twelfth, "the traveling salesman." 'Give a real 'honest to goodness' salesman an idea for developing business," says the bureau, "and he will produce more than a dozen mayors or groups of public-spirited citizens."

The bureau then adds one more factor to Mr. Hoover's recommendations by calling upon the salesman of heating and plumbing supplies, some 4000 in number, to go out and sell their customers' and their friends the plan recommended by the conference committee, especially with respect to using the winter time, instead of spring, for making repairs, alterations and additions to private houses, hotels, offices, etc. The salesmen will also be asked to foster the additional recommendation that "public construction is better than relief."

It is pointed out that existing circumstances are favorable to such work through the fact that over $700,000,000 worth of municipal bonds, the largest amount in history, have been sold in 1921. In furtherance of the bureau's idea, a series of newspaper advertisements has been prepared, together with circular letters, moving picture slides, and show-window suggestions covering the "Help Wanted" campaign.

Tests in Ozone-Equipped School Buildings.

Supplementing a recent paper published in THE HEATING AND VENTILATING MAGAZINE for September on "Some Practical Experiences with Ozone," the following figures have been obtained of the cases of sickness in a school building equipped with ozone apparatus, as compared with one ventilated in the usual manner. The report was compiled by Dr. William Weiss, Inspector of Hygiene for the St. Louis Board of Education, and covers the winter of 1920-1921.

REPORT OF CASES OF SICKNESS IN MULLANPHY AND SHAW SCHOOL BUILDINGS ST. LOUIS.

(Mullanphy School equipped with ozone apparatus, and the Shaw School ventilated according to St. Louis standards and selected as a check).

Causes of Sickness	Mullanphy School		Shaw School	
	Pupils Absent	Days Absent	Pupils Absent	Days Absent
Tonsilitis	13	65½	57	220
Sore Throat	24	68½	60	99
Cold	46	264	64	212
Headache	9	8½	66	92
Stomach Ache	..	..	25	40
Back Ache	..	..	8	11
Ear Ache	1	1	15	33
Tooth Ache	..	..	20	34
Indigestion	..	..	9	12
Fever	1	21	42	48
Chicken Pox	..	..	1	5
La Grippe	..	..	6	25
Pneumonia	..	..	4	104
Pain in Side	..	..	5	9
Diphtheria	1	11	..	..
Dizziness	2	2	..	..
Heart	1	10	..	..
Total	100	475	392	1098
Total Enrollment	1050		1300	

Formula for Strength of Rope.

How strong is a rope? At the Bureau of Standards laboratories in the Department of Commerce, tests have been made that have resulted in answering that question with a formula. For three-strand regular lay manila rope from ½ to 4½ in. in diameter, the following computation will give the breaking load of the rope:

The average breaking load in pounds equals 5,000 multiplied by the diameter of the rope in inches, multiplied by the diameter of the rope increased by one.

This will give, of course, the average maximum weight that the rope will hold, but the working load or the load that a contractor or safe-hauler may apply with proper safety and precaution would be considerably less than the load given by the formula.

Other data on rope are contained in Technologic Paper of the Bureau of Standards No. 198, by A. H. Stang and L. R. Strickenberg, which has just been issued.

New Apparatus and Appliances

A One-Pipe Vapor Heating System.

With the development of the years, which has brought us the one and two-pipe gravity steam heating system and, latterly, the two-pipe vapor heating system, it has remained for the Gorton & Lidgerwood Co., New York, to perfect and place on the market a one-pipe vapor heating system. As illustrated in Fig. 1, this system has the general piping plan as the ordinary single-pipe steam system, the only difference being in the addition of the Gorton vapor appliances. It is pointed out that it is not the piping plan that changes a steam system to a vapor system, but the appliances which are used for clearing the air from the system and permittting the vapor to circulate under a minimum pressure.

The Gorton single-pipe vapor system

GORTON VAPOR AIR RELIEF VALVE.

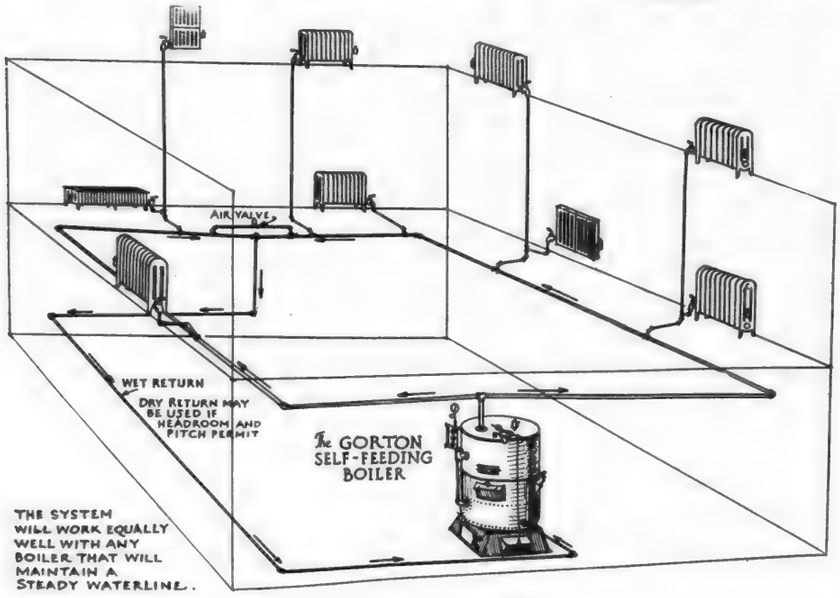
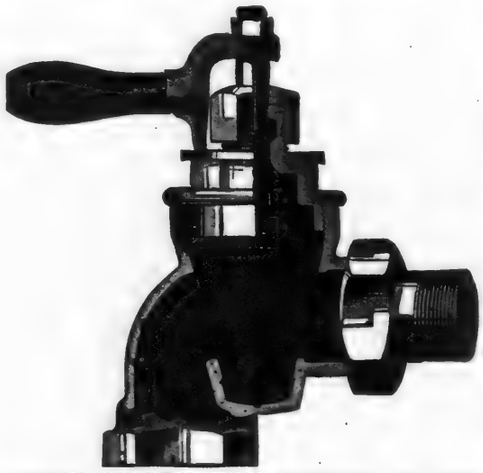

AIR VALVE
WET RETURN
DRY RETURN MAY BE USED IF HEADROOM AND PITCH PERMIT
The GORTON SELF-FEEDING BOILER
THE SYSTEM WILL WORK EQUALLY WELL WITH ANY BOILER THAT WILL MAINTAIN A STEADY WATERLINE.

DIAGRAM SHOWING STEAM MAIN BRANCHING BOTH WAYS FROM BOILER WITH EITHER WET OR DRY RETURN BACK TO BOILER.

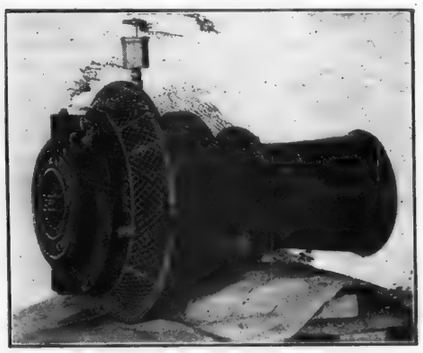


GORTON QUARTER-TURN RADIATOR VALVE.

operates under the same low vapor pressure as the two-pipe vapor system, which is from 4 to 12 oz., except on large installations. Its success, it is stated, is due to the Gorton vapor air relief valve and to the Gorton quarter-turn packing-lock radiator valve. The radiator valve itself is well known to heating engineers and contractors and a glance at its construction (Fig. 2) will show how it is adapted to one-pipe work in allowing unrestricted flow for both the vapor and the condensation. For this reason a 1 in. Gorton valve is recommended for use on a 60 sq. ft. radiator for single pipe connection. The Gorton vapor air relief valve (Fig. 3) is of the float type and works independently of any thermostatic action. The air passageway is entirely clear, its area being four times larger than that of an automatic air valve, thus permitting quick expulsion of air from the radiator, when the supply valve is open. Of course, when the radiator has been cleared of air, the vapor causes the inlet opening of the air relief valve to close. This serves to prevent any water from collecting in the valve. At the same time, as the outlet of the air relief valve is always open, it is impossible for a vacuum to form in it, thus overcoming the troubles due to water-logging.

Coppus Vano Blowers.

With the exception of low-duty ventilating fans, propeller blowers have been used almost exclusively for undergrate draft on handfired boilers, or with chain-

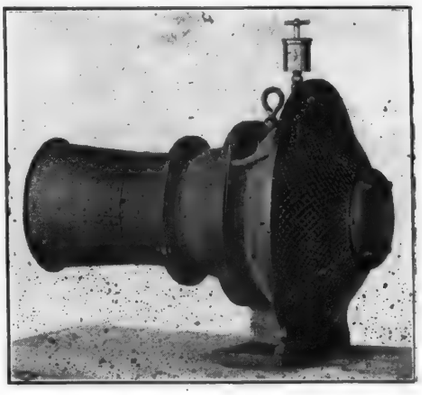


COPPUS TURBINE-DRIVEN VANO BLOWER.

grate and overfed stokers. This was due to their low efficiency at higher pressures.

A new type, however, known as the Coppus Vano blower, has just been placed on the market, which, in addition to the uses stated, is adapted for induced draft, main and individual room or tunnel ventilation for mines, air heating and drying work, cooling of electric motors and generators, and ventilation of factories, boiler rooms, ships, tunnels, etc.

These blowers, it is stated, operate against pressures up to 8 in. water, with an efficiency of 80%, while the power consumption at constant speed has been



COPPUS MOTOR-DRIVEN VANO BLOWER.

found to be unaffected by variations in air delivery or pressure.

The principal feature of the Coppus Engineering and Equipment Co., Worcester, Mass., is the stationary guide of peculiar design beyond the propeller. The air current leaving the propeller is radially sub-divided by the individual guide vane blades and taken up by them without shock. The guide vane blades which have a curvature, increasing in the direction of the rotation of the propeller, concentrate the air current and give it a further acceleration inside of the stationary guide vane so that a considerable part of the pressure is produced in the latter. A large part of the end thrust is thus taken up by the stationary guide vane casing. The air streams, into which the flow of air has been sub-divided by the guide vane blades, leave the guide vane casing, on

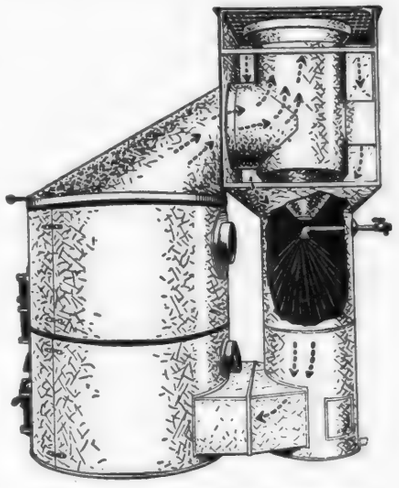
GUIDE VANE CASING OF VANO BLOWER

account of the kinetic energy, slightly rotating and convergent toward the axis so that the smallest section of the air flow is reached beyond the guide vane casing.

The design of the blowers is such that the air enters and leaves the blowers parallel to its axis. They are high-speed machines which require a comparatively small driving unit. On account, also of the compactness of design the blowers can readily be installed in pipe lines which, of course, is a distinct advantage in ventilating, heating and drying systems. It is stated that they work with the same effect and efficiency when installed at the entrance or at the end of the air duct, operating as blowers or exhausters, respectively.

A Dust-Consuming Pipeless Furnace.

One disadvantage of the ordinary pipeless furnace is that the large floor register usual to that type offers a splendid receptacle for dust and dirt. This would not be so bad except for the fact that the dust and dirt which it collects is very apt to be recirculated by the stream of warm air rising from the register. While it offers the same opportunity for the collection of solid impurities, the recirculation of these impurities is prevented in the Handelan dustless furnace, invent-



HANDELAN DUSTLESS FURNACE

ed by D. Handelan, 4901 Thirty-ninth Ave. S., Minneapolis, Minn.

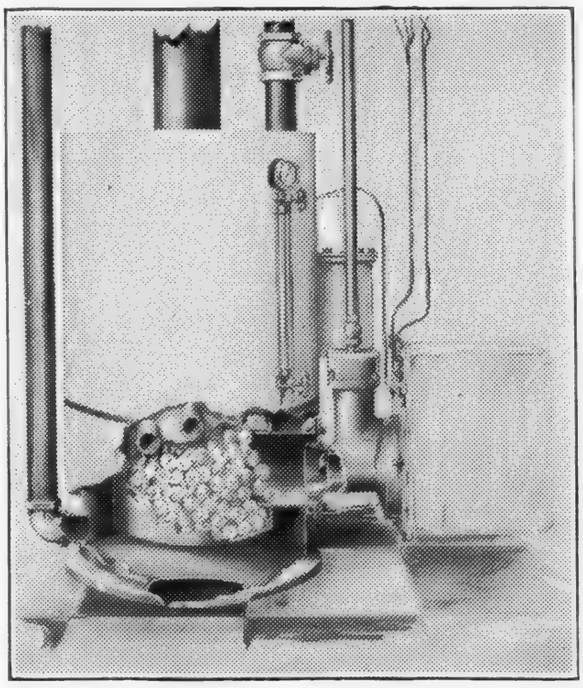
The mechanism and operation of this apparatus are quite obvious from the accompanying illustration. A dust-collecting casing of sheet metal is provided beneath the floor register and this is arranged so as to care for dust that may fall into the warm air duct as well as that which falls into the cold air portion of the register. At the lower portion of the dust collector is provided a spray which wets down the dust deposit and facilitates its quick and complete removal through the sewer or other drain connection. At the same time the spray provides a considerable degree of humidification, certainly more than can be obtained from any sort of water pan. A connection is required to the domestic water supply line and the spray is adjustable to the needs of the installation. The lower portion of the dust collector must be of copper or other rust-proof metal.

A Flameless Gas-Fired Boiler.

The Wales Company, of Kalamazoo, Mich., has put on the market a new type of gas-fired steam boiler which it calls the Immedi-Heater and for which it claims "flash" characteristics, combined with absolute safety and high efficiency. A thermostatic valve, operated by the pilot light, controls the flow of gas in the apparatus, so that when the pilot light is out the valve is closed and no gas can flow. This prevents accidental escape of gas with the resulting danger of explosion. By metering both gas and air supplies, this boiler maintains constantly the correct mixture for perfect combustion. The combustion chamber is packed with fire-brick granules so that instead of a flaming blast the combustion takes on the character of an incandescent glow. From this arrangement the makers claim higher evaporation efficiency and lower stack temperatures.

Air flow through this boiler is excluded when not in operation and the practical benefit of this design is claimed to be a longer retention of heat, which is a valuable feature when the boiler is used to heat a stored hot water supply. The manufacturers state that this boiler will generate steam in nine minutes from dead cold and will evaporate 200 lbs. of water per hour into steam up to 15 lbs. pressure. They claim for the boiler a thermal efficiency of 92%, based on the net calorific value of the gas.

PIERCE AMERICAN SMOKELESS BOILERS, of the updraft type, are described in a catalog of the Pierce, Butler & Pierce Manufacturing Corporation, New York. Its features are the use of headers at top and sides to which each section is connected, and a large grate area. A three-way fire travel enables the location of the breeching connection at the rear of the boiler.



SECTIONAL VIEW OF THE IMMEDI-HEATER.

THE EJECTOR SYSTEM OF AIR CIRCULATION FOR USE IN DRYING WORK

The method of air circulation and distribution now used by the Carrier Engineering Corporation in its drying installations is described in an interesting manner by J. E. Bolling, in the Journal of the heating engineer's society for October.

This system, which was designed by the Carrier Corporation employs the high-efficiency housed centrifugal fan, discharging the air through nozzles at a high velocity. The nozzles are located as shown in the accompanying illustration (Fig. 1) along one side of the kiln, near the ceiling. These high-velocity jets of air induce a secondary current of three or four times the original volume, which thoroughly mixes with the air from the nozzles, and passes with it overhead to the farther side of the room. Here the air is deflected downward along the opposite wall, and backward horizontally through the material, in a return circuit. All of the air passing through the material moves in a direction opposite to that of the discharge from the nozzles. A slight static pressure is built up on the farther side of the room, and a slight vacuum on the return side. This results in a strong and uniformly distributed return current through the material. The material may be either arranged in trays or suspended vertically from racks or trucks.

The ejector system is considered a development of great importance because it makes possible the circulation, within the kiln, of much larger volumes of air than are practicable otherwise. This is so because an apparatus which will condition and propel a given volume of air can, by means of this system, *circulate within the kiln from three to five times as much air.* Prior to the development of the ejector system it was often necessary to design a drying equipment with regard to the maximum allowable cost of apparatus, whereas we are now enabled to design the system with regard only to the maximum possible efficiency, the size of the apparatus being such, even for extremely large air volumes, that the cost is entirely commensurate with the results.

With this system, the arrangement of material is of great importance. Provision must be made for unobstructed passage of air between the sucessive tiers of material, and if material is arranged vertically, the air passages must be in the direction of the air flow. A certain

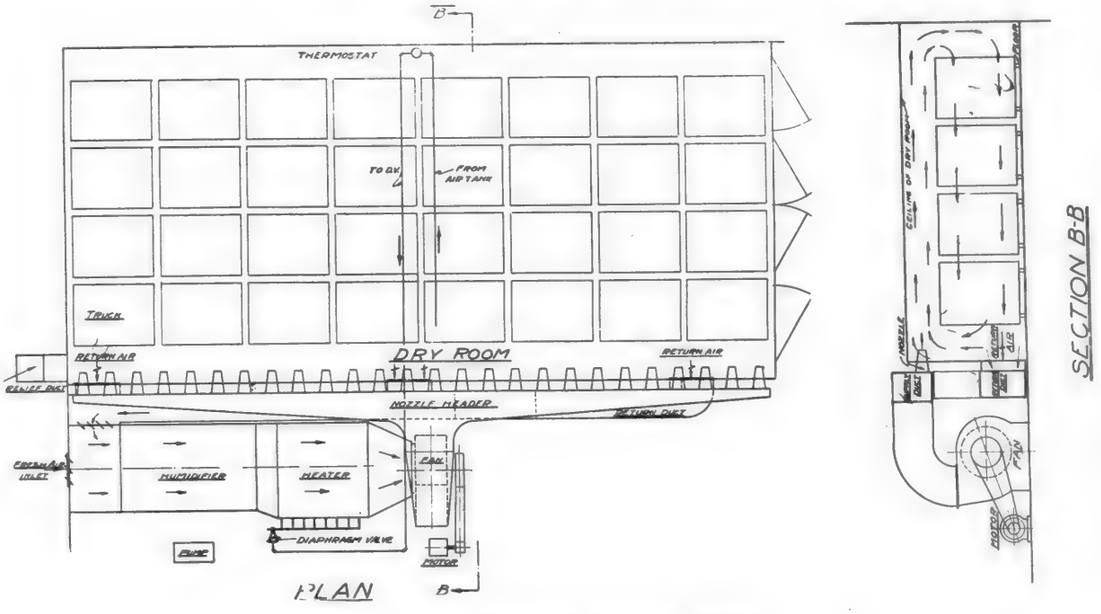


FIG. 1—CARRIER EJECTOR DRYER.

—CENTRAL STATION EJECTOR SYSTEM—

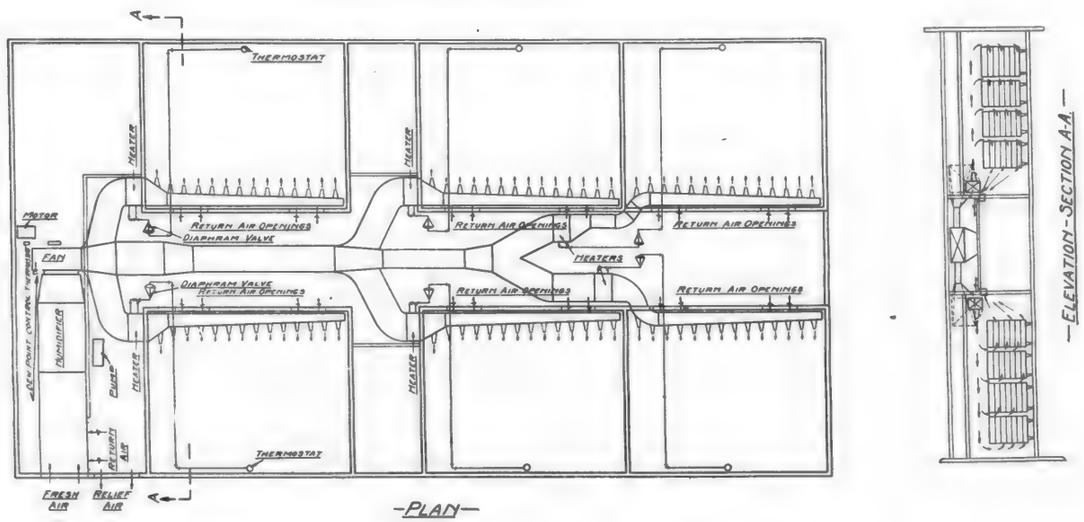


FIG. 2. CENTRAL STATION EJECTOR DRYER SYSTEM.

amount of space must be left in the front and back of the room, as well as between the top of the material and the ceiling, for ejector circulation. The humidity conditions are controlled either by a dew-point control and a humidifier, in which all of the air is brought to a definite point of saturation, and then reheated to maintain a definite room temperature, or else the control may be regulated by admixture of fresh and return air, controlled by a hygrostat located in the room. By either system, a very accurate humidity control may be secured. The temperature may be controlled independently.

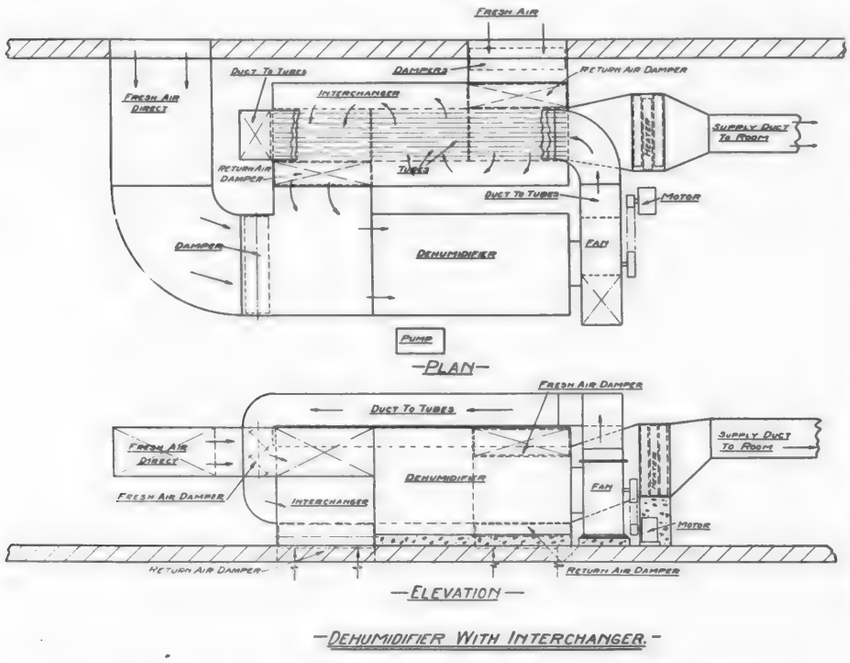
Fig. 2 shows a central station, where one apparatus supplies a group of dry rooms. For accurate humidity control with this system, a dew-point control is necessary, and various relative humidities may be obtained in each room, by regulation of the separate heater in the branch duct in each room. The unit system of apparatus, however, is usually preferable.

For low temperature work, it is necessary to use refrigeration for the removal of moisture, and this is accomplished by dehumidification, the air being brought into contact with a spray of refrigerated water at low temperatures, removing the excess moisture by condensation. The air is then reheated by means of heater coils, which supply the necessary heat for drying.

Fig. 3 shows a humidifier with interchanger, by means of which most of the heat of the warm return air is transferred to the cool dehumidified air, before it is supplied to the room. This permits a reduction of about one-third in the refrigerating capacity required for a given duty in low temperature drying.

It is generally found that about 2 lbs. of steam are required to evaporate 1 lb. of water, under the most favorable conditions, while the more usual figure for steam consumption is 2½ lbs. of steam to 1 lb. of water evaporated. The principal losses in air drying are radiation and escape of unsaturated air, either through the usual vent ducts or by leakage through the kiln walls.

The ejector system makes it possible to utilize air volumes greatly in excess of those allowable with other systems of circulation.



—DEHUMIDIFIER WITH INTERCHANGER.—

FIG. 3—ARRANGEMENT OF DEHUMIDIFER WITH INTERCHANGER.

Joint Experiments on Ozone Production and Effects.

The Pittsburgh Experimental Station of the United States Bureau of Mines is working in co-operation with the Research Bureau of the American Society of Heating and Ventilating Engineers on some problems of vital interest and importance in connection with air purification methods. The growing use of ozone in connection with recirculating systems is largely responsible for this activity.

It is the prevailing belief that ozone acts to purify the air by oxidation of solid and gaseous impurities and possibly by killing bacteria. But there is a question as to whether ozone will accomplish the latter function except in concentration sufficient to irritate throat and lung tissues. Also there is need of more thorough knowledge of the type of ozone producer which releases a minimum of the poisonous oxides of nitrogen.

The only practical method of investigating these points is by experiment. For this precision methods of chemical analysis have to be devised and applied to the determination of gaseous composition. Then the experiments have to include the biological effects of the different gases at different degrees of concentration. In this latter field the two agencies above mentioned will have the co-operation of the United States Public Health Service. Prominent in supervision of this work are A. C. Fieldner, R. R. Sayers, G. W. Jones, W. P. Yant, and O. W. Armspach.

Progress in Movement to Establish Warm-Air Furnace Code.

At a meeting of some 20 representatives of four different asssociations, including the heating engineers' society, the sheet metal conntractors' association, the Western Warm-Air Furnace and Supply Association and the Warm-Air Heating and Ventilating Association, held in Chicago, October 25, the following resolution was adopted:

RESOLVED: That a committee of six, consisting of one from the National Association of Sheet Metal Contractors, the National Warm Air Heating and Ventilating Association, the Western Warm Air Furnace and Supply Association, and three from the American Society of Heating and Ventilating Engineers, be appointed by the several organizations to prepare and submit a tentative code for the installation of warm-air furnaces to a future joint meeting of the committee composing the joint meeting in session, and that this special committee be requested to make its reports by February 1, 1922.

It will be recalled that at its convention held last May, the National Warm-Air Heating and Ventilation Association adopted a resolution expressing itself in favor of a furnace code conference and the Chicago meeting was the result of that resolution. Those present for the heating engineers' society were Professor James D. Hoffman, of Purdue University, Lafayette, Ind., and J. M. McHenry, of St. Louis. Others who attended were D. Rait Richardson, New York and Professor A. C. Willard, Urbana, Ill.

Boston's Second "Home Beautiful" Exposition.

Plans are going forward for the holding of the second "Home Beautiful" Exposition in Boston, April 15-29, 1922. The success of last year's exposition, which was the first to be held in this country, has led to space reservations for the forthcoming show by the majority of the large exhibitors and further requests for space indicate an increase of from 20% to 30% in the total of exhibitors.

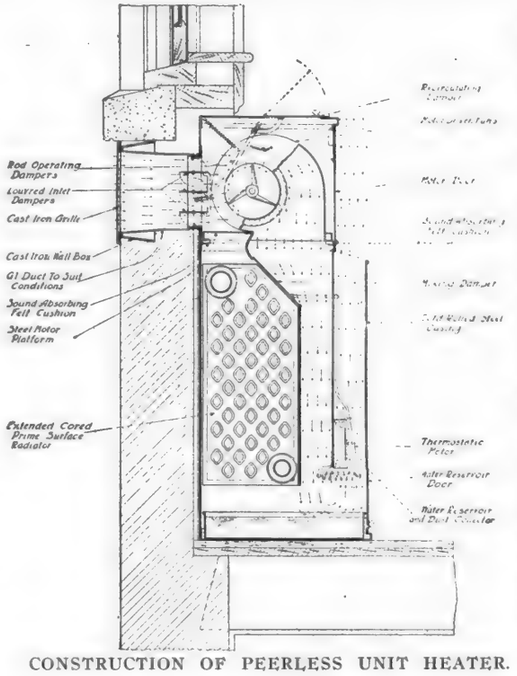
Among the features of the exposition, which will again be managed by Chester I. Campbell, will be a fully-equipped six-room house which will contain every worth-while appliance in the way of fittings and furnishing. There will also be a series of contests which will include the art poster announcing the exposition, and the awards in first and second prizes will total $1000.

The Mechanics Building, where the exposition will be held, is considered one of the finest structure in the country for this purpose, having one main hall and four other large halls, with a total floor space of 125,000 sq. ft. Its size may be judged from the fact that it is possible to erect a complete house in one hall and not inconvenience the other exhibitors.

Trade Literature.

CROWLEY'S CLASSIFIED BOOK OF BUSINESS, CLASS, PROFESSIONAL AND TECHNICAL PUBLICATIONS for 1921-1922, has been published by Crowley, "the magazine man," 511 East 164th Street, New York. Brief descriptions are given of each periodical for the benefit of prospective subscribers. A copy of the book, we understand, may be had for the asking to aid in making a selection of the journals for which one may desire to subscribe.

PEERLESS UNIT SYSTEM OF HEATING AND VENTILATING, now manufactured with all of the latest accessories, including means for humidifying the incoming air and even for ozonizing, is the subject of a new catalogue published by the Peerless Unit Ventilation Co., Inc., 437-439 West 16th Street, New York. Numerous illustrations are included showing how this system may be adapted to large and small buildings. As now furnished, the unit, which is intended to be set near a window, taking in outdoor air at that point, is self-contained within a cabinet made of furniture steel. It is so arranged that the fresh air can be brought in from out-of-doors, warmed if desired and circulated throughout the room, or the air in the room can be recirculated. The air is circulated by a special constant-speed motor with extended shafts on which are mounted two aluminum multiblade fans. A cast-iron prime surface radiator of the Vento type is located in the heating chamber of the unit. A water reservoir in the bottom of the cabinet is so placed that the incoming air meets a sheet of water which acts as a deflector and drives the air upward to the outlet, at the same time removing dust and dirt and imparting humidity to the air.

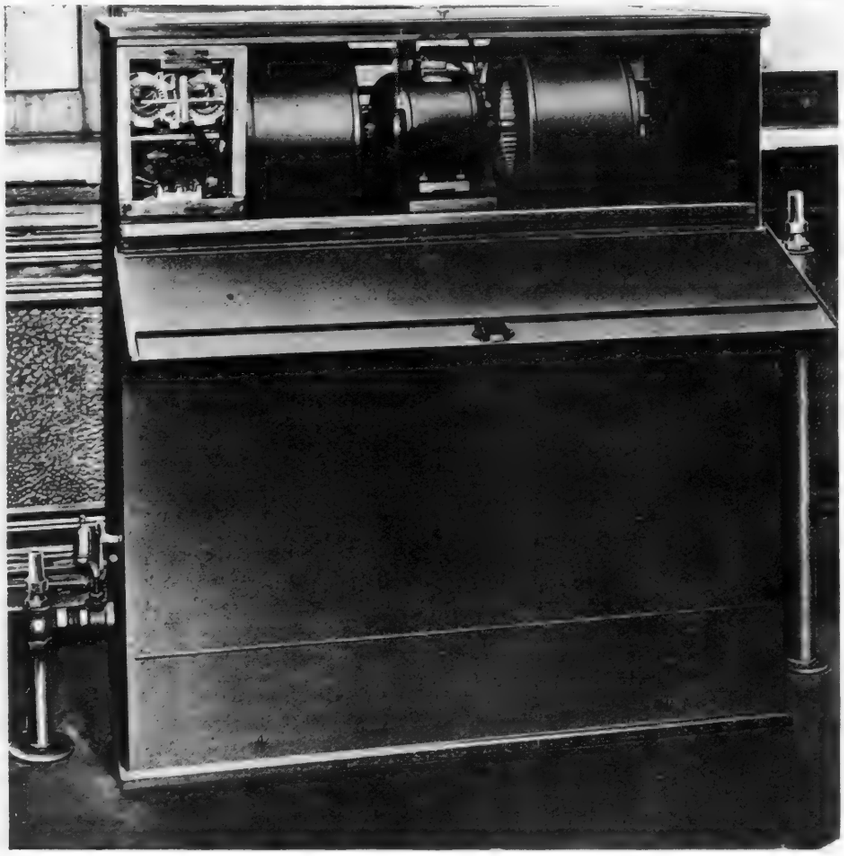


CONSTRUCTION OF PEERLESS UNIT HEATER.

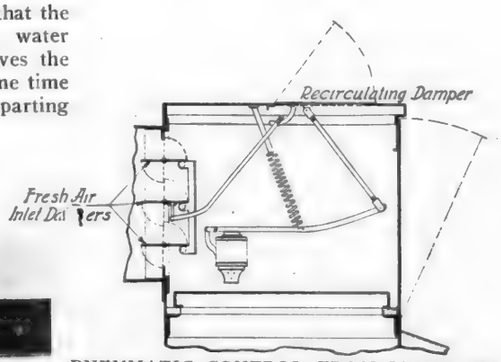
The air, in leaving the unit, is directed toward the ceiling. Louvre dampers in the fresh-air inlet make it possible to recirculate the air when desired. These are supplemented by an air-mixing damper, operated by hand or automatic control which permits a wide range of temperature regulation.

Finally, the unit is provided, when desired, with special supplementary electrical apparatus for the generation of ozone and its introduction into the ventilating air current. The ozonator is provided with special control for operation only when needed, which usually is only when the air is being recirculated.

The catalogue discusses in detail the advantages of this system and gives directions for the benefit of the designing engineer, including engineering data. Some interesting figures are also included of some typical performances of the Peerless units. Size 8 x 10½ in. Pp. 28.



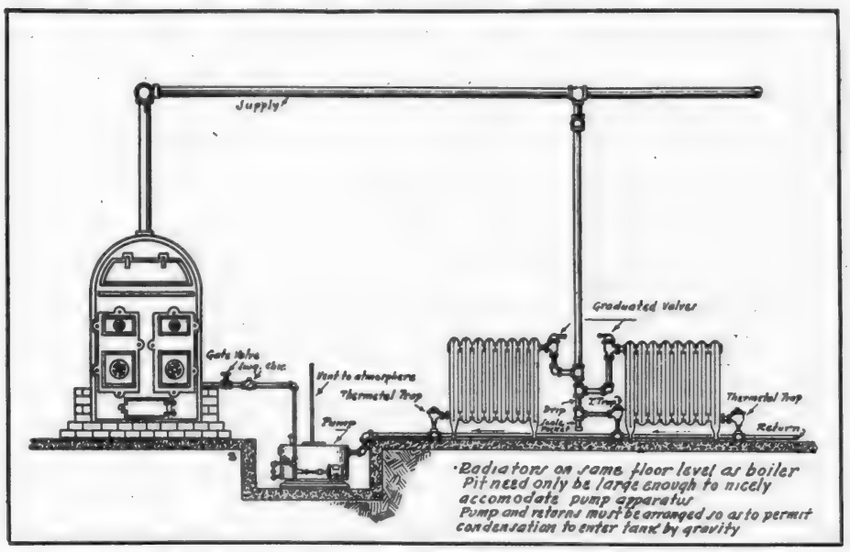
TYPICAL PEERLESS UNIT HEATER INSTALLATION WITH AUXILIARY OZONE APPARATUS FOR PURIFYING RECIRCULATED AIR.



PNEUMATIC CONTROL FROM JANITOR'S OFFICE OF PEERLESS UNIT HEATERS.

PROPER HUMIDITY AND HOW TO GET IT are discussed in a new catalogue of the American Moistening Co., Boston, Mass., and devoted to the Comins' sectional humidifiers, fan and high-duty humidifiers, ventilating type of humidifiers, atomizer or compressed air system, automatic humidity control, conditioning room equipments, compressed air-cleaning systems, dampening or dewing machines, automatic temperature control and spray-cooling pond systems, intended especially for use in textile mills. Illustrations of the principal devices and apparatus accompany the text. A number of views is also included of typical installations. Size 8 x 10½ in. Pp. 16.

TRANE CONDENSATION PUMPS, automatic electrically driven, are treated in two new bulletins, published by the Trane Co., Chicago, Ill. One bulletin (No. 2) is a re-issue of a previous bulletin and contains some very substantial price reductions on all low-pressure condensation pumps. It shows the application of these pumps to factory work and their usefulness in remodeling old jobs. The listings show the wide range of sizes covering requirements up to 30,000 sq. ft. of radiation and against varying boiler pres-



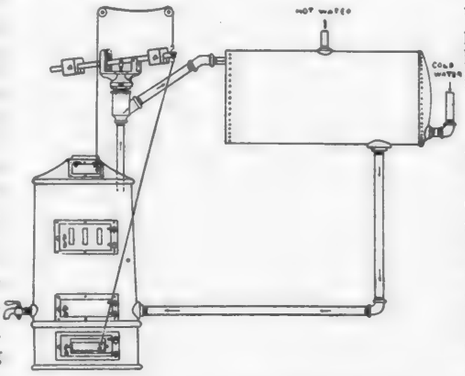
ARRANGEMENT OF TRANE CONDENSATION PUMP AS USED IN FACTORIES, GARAGES AND OTHER BUILDINGS.

sures up to 60 lbs. Complete specifications are given, together with typical installation details. The other bulletin (No. 3) is devoted to the Unit One Trane pump, which is described as a development of the ordinary centrifugal pump, perform more like a piston pump because of its ability to pump high pressures, and because it requires a minimum of power at low heads. The three sizes listed are all made with an impellor less than 5 in. in diameter. The listing shows the capacity at various heads or pressures up to 20 lbs. Size 6 x 9 in. Pp. 8 and 2, respectively. (Punched for loose binding).

ECONOMY SMOKELESS BOILERS, described as "the boilers that burn the gases as well as the coal," are presented in a well-compiled catalogue received from the International Heater Co., Utica, N. Y. The catalogue is devoted to the company's new 47-in. series which is made in seventeen sizes with rating ranging from 6900 sq. ft. direct steam radiation to 14,900 sq. ft. This large boiler, which is the latest addition to the International line, makes it possible for the heating contractor to supply an Economy boiler on practically any installation from the home to institutional work to which this new size is especially adapted. The descriptive text includes a readable discussion of the smokeless boiler principle, taking up such items as requirements for smokeless combustion, excess air control, and methods of firing soft coal. Sixteen reasons are given for specifying and stalling Economy smokeless boilers. The catalogue concludes with tabular information as to dimensions, and other data. Size 6¾ x 9¾ in. Pp. 16.

WESTERN AUTOMATIC ELECTRIC CONDENSATION PUMPS AND RECEIVERS, manufactured by the Western Engineering Co., Davenport, Ia., are explained and illustrated in a recent folder which emphasizes the point that these pumps are suitable for either high or low pressures and it is not necessary for them to be multi-staged. The pumps are cast-iron, with bronze impellors and outboard ball-thrust bearings, with the exception of the two smallest sizes which are furnished with all bronze pumps. The receivers on all outfits are built of heavy cast-iron, while the switches are of the enclosed but-contact tape, furnished with time-limit protective fuses. The entire unit is mounted on one cast-iron base and is shipped completely assembled so that two pipe connections are all that are required to complete the installation. The folder concludes with a dimension sheet for estimating purposes.

METAPHRAM DAMPER REGULATORS for high pressure, low pressure, hot water and vapor, are illustrated and described in a circular of the National Regulator Co., Chicago, Ill. The regulators shown include the company's new Type F, or 2-in. water boiler regulator, which is self-contained and is screwed into a section of the boiler or other line and connected by chain to the drafts. The rise and fall of the lever, actuated by the thermostat, furnishes the motion. This regulator, it is stated, can be taken apart and the thermostat renewed or discarded without the necessity of draining the boiler. By adjusting the weights on the lever, the temperature of the water tank may be controlled within 5°, thus preventing overheated or underheated conditions.

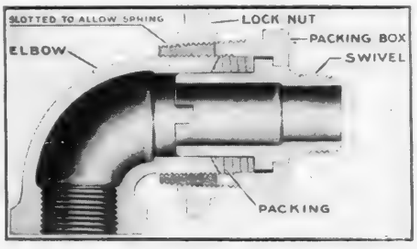


TYPICAL INSTALLATION OF NEW TYPE F METAPHRAM REGULATOR.

THE WEATHER VEIN for November, the monthly periodical of the Carrier Engineering Corporation, Newark, N. J., is featured as a "Piping Number," in which an account is given of the many uses of piping which is characterized as "the arteries of civilization." Numerous illustrations show the character and extent of the piping work designed and installed by the corporation's piping division. Further adventures of "the Mechanical Weather Man" are depicted under the title of "The Piping Incident."

TURNING WASTE INTO MILLIONS is the alluring title of a pamphlet received from the Burnrite Coal Securities Corporation of New Jersey, Newark, N. J. This waste, it is shown, is in the authracite culm banks and its transformation into "millions" is through the process of making Burnrite briquettes out of the coal dust. A view is included of the company's plant in Perth Amboy, N. J. Size 6 x 9 in. Pp. 48.

ATLAS AND IDEAL REDUCING VALVES, pump governors, vacuum and pressure regulators, and balanced valves, and Victor hot water tank regulators, control valves and damper regulators, are brought to the attention of the trade in a new catalogue published by the Atlas Valve Co., Newark, N. J. Numerous illustrations of the company's product accompany the text, the catalogue constituting a handy reference manual. Size 3½ x 6¼ in. Pp. 20.

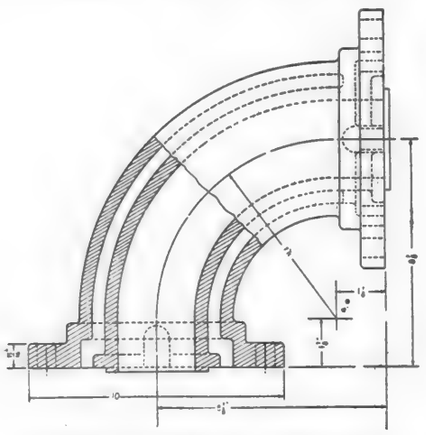


ATLAS SWING-JOINT FITTING.

HOT WATER AT LOWEST COST is the attractive title of a well-designed blanket folder featuring the Excelso water heater, manufactured by the Excelso Specialty Works, Buffalo, N. Y. An abundant supply of hot water at all times and all this without a fire-pot coil, are made possible through the construction of the Excelso heater which consists of a heavy copper coil heating element fitted in a cast-iron shell by means of ground joint connections, without the use of packing. It is connected below the water line on the outside of the boiler. The water from the heating boiler flows through the cast-iron shell at boiling temperature, in this way heating the domestic water circulating through the copper coil. The manufacturer makes a special form of rotary hack saw for use in cutting holes through the metal of the boiler to fit pipe size taps. Included in the folder are reproductions of some of the leading journals, including THE HEATING AND

VENTILATING MAGAZINE, through which the Excelso water heaters are being brought to the attention of the trade and to the public generally.

STEAM-JACKETED PUMPS AND STEAM-JACKETED PIPE FITTINGS, for special use where asphalts and similar materials are handled, are the subject of a catalogue published by Guyton & Cumfer Mfg. Co., Chicago, Ill. The steam jacketing serves



CORRECT STEAM-JACKETED ELBOW LONG SWEEP.

to maintain the proper temperature for holding the materials in liquid form within the piping, removing the necessity for using torches or fire pots in dangerous contact with inflammable oils and gases. Size 8 x 11 in. Pp. 12. (Punched for loose binding).

New Publications.

WASTE IN INDUSTRY is the title of a book, just published by the Federated American Engineering Societies, which, in the opinion of the reviewer, marks the beginning of a new era in American industry. This book first admits frankly its own limitations and then proceeds to lay before the reader some of the most valuable information that has ever been collected relative to the larger aspects of industrial activity. Initiative for the effort came from Herbert Hoover, then president of the above organization, while the study was directed by seventeen members of that body's Committee on Elimination of Waste in Industry. This volume covers investigations of the building industry, men's ready-made clothing manufacturing, boot and shoe manufacturing, printing, metal trades, and textile manufacturing. The field work of this survey was done by fifty engineers, each a specialist in the line to which he was assigned.

The findings of this study are summarized briefly at the start of the book, industrial waste being attributed to four main causes: first, low production caused by faulty management of materials, plant, equipment, and men; second, interrupted production caused by idle men, idle materials, idle plants, and idle equipment; third, restricted production intentionally caused by owners, management, or labor; and fourth, lost production caused by ill health, physical defects, and industrial accidents.

From this study it appears that about 68% of the waste is chargeable against defects of management, about 16% against labor, and about 16% against a combination of other smaller factors. In each of the industries studied there were found outstanding examples of good management to the efficiency of which the bulk of the industry did not even approximate. The book takes up in great detail the various causes of waste and its findings lay the basis for the best kind of theory because the method is distinctly practical. It is believed that further study along the same line will alter some of the conclusions of this report and intensify others, but there is no question as to its large present value for every industrial executive and engineer. No one who reads this book can avoid catching the faint suggestion of a new industrial order in which stubborn muddling gives place to intelligent leadership for mass welfare. The book contains 397 pages and an 11-page index, octavo size, and sells for $4.00 net. It can be obtained direct from the McGraw-Hill Book Co., Inc., New York, or through the book department of HEATING AND VENTILATING MAGAZINE.

BULLETIN OF THE NATIONAL DISTRICT HEATING ASSOCIATION for October 15, 1921, contains the interesting announcement that the "Handbook for Central Station Heating Engineers" is now ready for delivery. The first edition of the handbook, which is a complication of data on central station heating work, is limited to 1000 copies of which 400 will be bound. The Bulletin also contains a supplementary list of heating rates as collected by the association for the years 1921-1922. In commenting upon these rates, it is stated editorially that those companies which have rates based upon coal prices will, of course, suffer a reduction this year from last. Not many companies are making reduction of rates where such rates are fixed by commissions or are not subject to coal clauses. Finally, the opinion is expressed that the public need never expect to return to pre-war rates for heating. The Bulletin also announces that the Proceedings of the association for 1921 are now ready for delivery.

BASIC SPECIFICATIONS FOR TILEWORK AND DOCUMENTS RELATING TO SPECIFICATIONS FOR TILEWORK, including "work sheets" for specification writers, are two noteworthy publications that are the result of some two years of preparation on the part of the Structural Service Bureau, Philadelphia, Pa., of which D. Knickerbacker Boyd is architectural adviser and structural standardist. While relating only indirectly to heating and ventilating work, the character and arrangement of the publications, which are designed to simplify architectural practice with respect to the use of one product and all collateral matters connected with the use of that product, set a high standard that could be followed with advantage in other lines. The two publications are issued under the name of the Associated Tile Manufacturers, Beaver Falls, Pa.

1921 YEAR BOOK of the American Society of Heating and Ventilating Engineers, corrected to September 1, 1921, has been issued. It contains the names and connections of the 1388 members of the society, of whom, 1177 are full members. The society's constitution is also incorporated in the booklet. Size 4x6 in. Pp. 152. Price to non-members, $1.00.

Death of Stephen F. McDonald

A figure well known in the heating trade through the middle west passed on when Stephen F. McDonald, head of the McDonald Under-Seat Valve Co., Cleveland, O., died, October 31, at the age of 57. Mr. McDonald was born in Holden, Mass., and obtained his early training as a heating engineer with the O. S. Kendall Company, of Worcester, Mass., and later with A. B. Franklin, of Boston.

He went to Chicago in 1897 to represent the Western Paul System Company, remaining with that company in Chicago until 1900. He then went to Cleveland where he represented the same company until 1904.

In that year Mr. McDonald organized the McDonald Bros. Company which continued in business until 1914. He then acquired the Mack ventilator which he handled until 1917. The following year he began to market the McDonald underseat valve, which represented many years of inventive effort on his part. At the time of his death he was at the head of the McDonald Under-Seat Valve Company and it is announced that the business will be continued by his associates. He had recently sold his interests in the Mack Ventilator to the Stark Sheet Metal Works Company, of Canton, O.

Deaths.

JOHN F. ROBERTSON, head of John F. Robertson Co., Pittsburgh, Pa., manufacturer of steam specialties, died at the Suburban Hospital, Bellevue, Pa., October 19, following a surgical operation. Mr. Robertson, who was also president of the Lawrenceville Bronze Company and of the Neville Lubricator, was the inventor of the Robertson turbo-steam trap and the Robertson blow-off sentinel, an automatic safety valve. He was 47 years old.

JOHN MAGEE, for many years president of the Magee Furnace Co., Boston, Mass., died November 7 at his home in Grafton. He was 73 years old. Mr. Magee was a son of the founder of the company. He retired from active business about ten years ago.

Contracts Awarded.

Samuel Esswein Co., Columbus, O., heating, ventilating and plumbing new North High School building in Columbus, for $37,774. Plumbing new Olentangy School building in Columbus, for $37,774.

W. H. Welch & Co., Boston, Mass., was low bidder at $42,838, for the heating and ventilating of the new Junior High School building in Newton, Mass.

In many homes, particularly town houses or apartments, the space for the heating boiler is very small and frequently adjoins the entrance hall. The IDEAL Type "A" Heat Machine is admirably designed for plans of this character

Economy of Fuel and Space

"It burned 40% LESS COAL this year."—This statement from a grateful owner exceeds the tabulated results from hundreds of installations of IDEAL Type "A" Heat Machines—which average **A FUEL SAVING OF ONE-THIRD.** Besides this fuel economy, this reduced amount of coal requires one-third less storage space, and caretaking.

The **Large Fuel Chamber** holds enough coal to run without attention from 8 to 24 hours, depending upon weather demands.

The **Revertible Flues** and scientifically proportioned surfaces absorb and utilize the heat, preventing its waste up the chimney.

The **Automatic Regulation** prevents waste of heat by controlling the fire to supply the exact volume of heat needed—avoiding *under*-heating and *over*-heating..

The **Ideal Insulated Jacket,** dust-free and gas-tight, permits converting the basement into livable, recreational quarters.

We offer testimonial letters from many prominent users. Specify and use IDEAL Type "A" HEAT MACHINES for NEW or OLD residences.

Write for catalog containing test charts of FUEL ECONOMY and efficiency.

IDEAL Type "A" Heat Machine

IDEAL products are nationally priced and sold by all heating contractors. No exclusive Agents.

AMERICAN RADIATOR COMPANY

Sales Branches in All Large cities

Makers of the world-famous **IDEAL Boilers** *and* **AMERICAN Radiators**

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING CHARTS.

Windows.

Based on single thickness of glass. K factor = 1. Heat emission from radiators, 250 B. T. U. For temperatures other than 0° F. add 1.43% for each degree.

TABLE I

SQUARE FT. OF DIRECT CAST IRON STEAM RADIATION FOR HEAT LOSS THROUGH TWO PANE WINDOWS; INCLUDING SASH. ROOM TEMP 70° FAHR. OUTSIDE TEMP. 0° F.

WIDTH OF GLASS INS.	WIDTH OF OPENING Ft. IN.	HEIGHT GLASS	HEIGHT OPENING	STANDARD SIZES OF TWO-LIGHT WINDOWS	18"	20"	22"	24"	26"	28"	30"	32"	34"	36"	38"	40"	42"	44"	46"	48"	50"	52"	54"
					3'-6"	3'-10"	4'-2"	4'-6"	4'-10"	5'-2"	5'-6"	5'-10"	6'-2"	6'-6"	6'-10"	7'-2"	7'-6"	7'-10"	8'-2"	8'-6"	8'-10"	9'-2"	9'-6"
16	1-8				2.69	2.94	3.22	3.45	3.68	3.96	4.23	4.46	4.74	4.97	5.24	5.47	5.78	5.98	6.26	6.53	6.76	6.99	7.27
18	1-10				2.94	3.22	3.49	3.77	4.09	4.37	4.65	4.92	5.20	5.47	5.75	6.03	6.30	6.55	6.90	7.18	7.45	7.73	8.00
20	2-0				3.22	3.54	3.82	4.14	4.46	4.74	5.06	5.35	5.66	5.98	6.26	6.58	6.90	7.18	7.50	7.82	8.14	8.42	8.74
22	2-2				3.40	3.82	4.14	4.46	4.83	5.15	5.47	5.80	6.16	6.44	6.76	7.13	7.45	7.82	8.14	8.46	8.83	9.11	9.45
24	2-4				3.77	4.09	4.46	4.83	5.20	5.52	5.89	6.26	6.62	6.95	7.31	7.68	8.00	8.37	8.74	9.11	9.48	9.84	10.21
26	2-6				3.99	4.42	4.78	5.15	5.52	5.89	6.30	6.72	7.06	7.45	7.87	8.23	8.60	8.97	9.36	9.75	10.12	10.50	10.95
28	2-8				4.28	4.69	5.11	5.52	5.93	6.35	6.76	7.13	7.54	7.96	8.37	8.79	9.20	9.57	10.03	10.39	10.81	11.22	11.64
30	2-10				4.60	4.97	5.43	5.89	6.30	6.72	7.18	7.59	8.05	8.46	8.88	9.34	9.75	10.21	10.67	11.04	11.50	11.96	12.42
32	3-0				4.83	5.29	5.75	6.21	6.67	7.13	7.59	8.05	8.51	8.97	9.43	9.89	10.35	10.81	11.27	11.73	12.19	12.65	13.11
34	3-2				5.06	5.57	6.07	6.58	7.04	7.54	8.00	8.51	8.97	9.48	9.94	10.40	10.90	11.41	11.87	12.42	12.88	13.34	13.80
36	3-4				5.38	5.89	6.39	6.90	7.41	7.91	8.42	8.97	9.43	9.94	10.49	10.95	11.50	12.01	12.51	13.02	13.52	14.03	14.50
38	3-6				5.61	6.16	6.72	7.27	7.77	8.28	8.83	9.30	9.94	10.44	11.04	11.50	12.05	12.60	13.16	13.71	14.26	14.77	15.27
40	3-8				5.89	6.44	7.04	7.59	8.14	8.69	9.25	9.84	10.39	10.95	11.55	12.05	12.60	13.20	13.80	14.35	14.90	15.46	16.05
42	3-10				6.16	6.76	7.36	7.96	8.51	9.11	9.66	10.30	10.86	11.45	12.05	12.60	13.16	13.80	14.40	14.99	15.55	16.10	16.74
44	4-0				6.44	7.04	7.68	8.28	8.88	9.52	10.12	10.76	11.32	11.96	12.56	13.16	13.80	14.40	14.99	15.64	16.24	16.79	17.48
46	4-2				6.72	7.36	8.00	8.65	9.25	9.89	10.58	11.22	11.78	12.47	13.06	13.71	14.35	14.99	15.64	16.33	16.93	17.57	18.22
48	4-4				6.99	7.64	8.28	8.97	9.61	10.30	10.95	11.64	12.28	12.93	13.57	14.26	14.90	15.64	16.28	16.93	17.62	18.22	18.86
50	4-6				7.22	7.91	8.60	9.34	10.03	10.67	11.41	12.05	12.74	13.43	14.12	14.81	15.50	16.19	16.88	17.57	18.26	18.95	19.59
52	4-8				7.49	8.23	8.92	9.66	10.35	11.04	11.78	12.51	13.20	13.94	14.63	15.36	16.10	16.79	17.48	18.22	18.95	19.64	20.33
54	4-10				7.77	8.51	9.25	10.03	10.76	11.50	12.24	12.97	13.71	14.44	15.13	15.92	16.65	17.39	18.17	18.86	19.64	20.38	21.16
56	5-0				8.05	8.86	9.57	10.35	11.13	11.89	12.65	13.34	14.17	14.95	15.64	16.47	17.25	18.31	18.77	19.55	20.33	21.16	21.85

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RADIATION COMPUTING—WINDOW HEAT LOSS CHART. NO. 13-D.

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

RADIATION COMPUTING CHARTS.

Walls.

Based on 12-in. brick wall, furred and plastered, K factor = 0.26. Heat emission from radiators, 250 B. T. U. For temperatures other than 0° F. add 1.43% for each degree. For other building materials, multiply the values selected by a factor obtained by dividing the K factor for the material of which the building is constructed, by 0.26.

TABLE II

SQUARE FT. OF DIRECT CAST IRON STEAM RADIATION FOR HEAT LOSS THRU WALL AREA OF VARIOUS DIMENSIONS. ROOM TEMP. 70° FAHR. OUTSIDE TEMP. 0°

Height of Ceiling	Running Feet of Exposed Wall Without Regard to Window Openings																							
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24					
8	5.28	6.16	7.04	7.92	8.80	9.60	10.56	11.44	12.32	13.20	14.08	14.96	15.84	16.72	17.60	18.48	19.36	20.24	21.12					
8½	5.61	6.60	7.48	8.36	9.35	10.34	11.22	12.10	13.09	13.97	14.96	15.95	16.83	17.82	18.70	19.58	20.57	21.45	22.44					
9	5.94	6.93	7.92	8.91	9.90	10.89	11.88	12.87	13.86	14.85	15.84	16.83	17.82	18.81	19.80	20.79	21.78	22.77	23.76					
9½	6.27	7.26	8.36	9.46	10.45	11.55	12.54	13.53	14.63	15.62	16.72	17.71	18.81	19.91	20.90	22.00	22.99	23.98	25.08					
10	6.60	7.70	8.80	9.90	11.00	12.10	13.20	14.30	15.40	16.50	17.60	18.70	19.80	20.90	22.00	23.10	24.20	25.30	26.40					
10½	6.93	8.03	9.24	10.34	11.55	12.65	13.86	14.96	16.17	17.27	18.48	19.58	20.79	21.89	23.10	24.20	25.41	26.62	27.72					
11	7.26	8.47	9.66	10.89	12.10	13.31	14.52	15.73	16.94	18.15	19.36	20.57	21.78	22.99	24.20	25.41	26.62	27.83	29.04					
11½	7.59	8.80	10.12	11.44	12.65	13.86	15.18	16.39	17.71	18.92	20.24	21.45	22.77	23.98	25.30	26.51	27.83	29.15	30.36					
12	7.92	9.24	10.56	11.88	13.20	14.52	15.84	17.16	18.48	19.80	21.12	22.44	23.76	25.08	26.40	27.72	29.04	30.36	31.68					
12½	8.25	9.57	11.00	12.32	13.75	15.07	16.50	17.82	19.25	20.57	22.00	23.32	24.75	26.18	27.50	28.82	30.25	31.57	33.00					
13	8.58	10.01	11.44	12.87	14.30	15.73	17.16	18.59	19.91	21.45	22.88	24.31	25.74	27.17	28.60	30.03	31.46	32.89	34.32					
14	9.24	10.78	12.32	13.56	15.40	16.94	18.48	20.02	21.56	23.10	24.64	26.18	27.72	29.26	30.80	32.34	33.88	35.42	36.96					
Ceiling Height	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43					
8	22.00	22.88	23.76	24.64	25.52	26.40	27.28	28.16	29.04	29.92	30.80	31.68	32.56	33.44	34.32	35.20	36.08	36.96	37.84					
8½	23.32	24.31	25.30	26.18	27.06	28.05	28.93	29.92	30.80	31.79	32.78	33.66	34.65	35.53	36.52	37.40	38.39	39.27	40.26					
9	24.75	25.74	26.73	27.72	28.71	29.70	30.69	31.68	32.67	33.66	34.65	35.64	36.63	37.62	38.61	39.60	40.59	41.58	42.57					
9½	26.07	27.17	28.16	29.26	30.25	31.35	32.34	33.44	34.43	35.53	36.52	37.62	38.61	39.71	40.70	41.80	42.79	43.89	44.88					
10	27.50	28.60	29.70	30.80	31.90	33.00	34.10	35.20	36.30	37.40	38.50	39.60	40.70	41.80	42.90	44.00	45.10	46.20	47.30					
10½	28.82	30.03	31.13	32.34	33.55	34.65	35.75	36.96	38.06	39.27	40.37	41.58	42.68	43.89	44.99	46.20	47.30	48.51	49.61					
11	30.25	31.46	32.67	33.88	35.09	36.30	37.51	38.72	39.93	41.14	42.35	43.56	44.77	45.98	47.19	48.40	49.61	50.82	52.03					
11½	31.57	32.89	34.10	35.42	36.63	37.95	39.16	40.48	41.69	43.01	44.33	45.54	46.86	48.07	49.39	50.60	51.81	53.13	54.34					
12	33.00	34.32	35.64	36.96	38.28	39.60	40.92	42.24	43.56	44.88	46.20	47.52	48.84	50.16	51.48	52.80	54.12	55.44	56.76					
12½	34.32	35.75	37.07	38.50	39.82	41.25	42.57	44.00	45.32	46.75	48.07	49.50	50.82	52.25	53.57	55.00	56.32	57.75	59.07					
13	35.75	37.18	38.61	40.04	41.47	42.90	44.33	45.76	47.19	48.62	50.05	51.48	52.91	54.34	55.77	57.20	58.63	60.06	61.49					
14	38.50	40.04	41.58	43.12	44.66	46.20	47.74	49.28	50.82	52.36	53.90	55.44	56.98	58.52	60.06	61.60	63.14	64.68	66.22					

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RADIATION COMPUTING—WALL HEAT LOSS CHART. NO. 13-E.

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

VAPOR HEATING.

The Donnelly Fractional Distribution System.

The primary object in the Donnelly one-pipe and two-pipe fractional distribution systems (Donnelly Systems Co., New York) is to obtain fractional control of the steam supply and to effect distribution to the various radiators under varying weather conditions. In each system the fractional generation of steam is accomplished by means of a regulator (Fig. 3). In addition each radiator is provided with a packless inlet valve (Fig. 4).

In the one-pipe system the air is exhausted by means of a weight-controlled vacuum air valve on each radiator (Fig. 5). Distribution to radiators is obtained by proper selection of pipe sizes and by variously wighting the vacuum air valves. The vacuum attachment to the air valve consists of a tight-fitting cap which contains a valve stem and seat, weighted by means of a number of removable washers. In applying these the maximum number of washers is placed on the air valve nearest the boiler. For other radiators, the rough rule is to remove one washer for each 10 ft. away from the radiator nearest the boiler. This adjusts the weight over the area in each cap so that all air valves will discharge at the same time when the pressure drop in the piping is 1 oz. per 100 ft. of pipe.

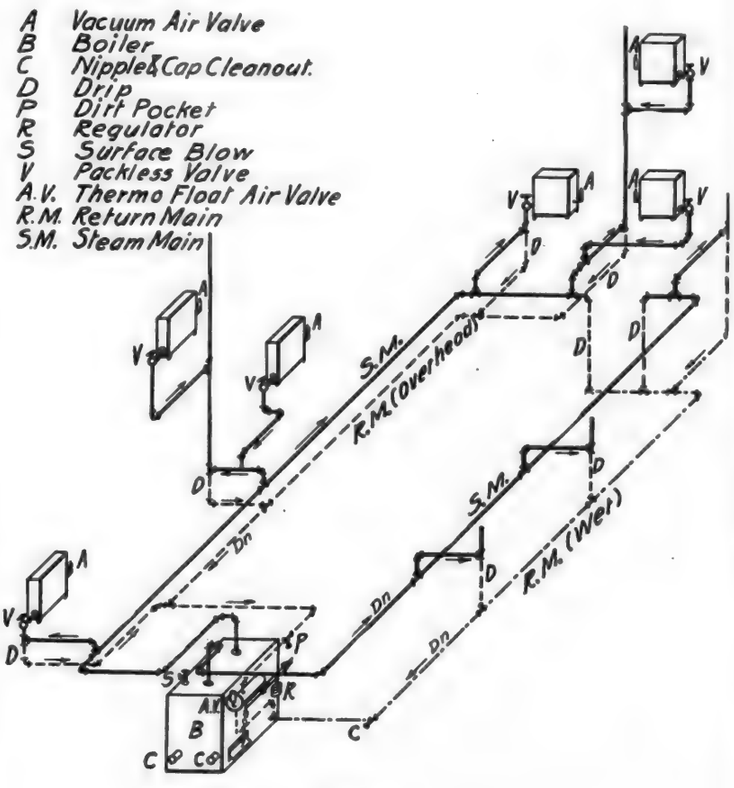


FIG. 1.

(Continued on Data Sheet No. 132-EE.)

VAPOR HEATING—THE DONNELLY SYSTEM. NO. 132-DD.

Copies of this Data Sheet, printed separately, 5 cents each.

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. CITY

VAPOR HEATING

The Donnelly Fractional Distribution System.

(*Continued from data Sheet No. 132-DD.*)

In the two-pipe system, in addition to the packless inlet valve, each radiator is provided with an impulse check valve (Fig. 6) at the outlet, together with thermo-float air valves (Fig. 7) located on the dry return mains before they drop to the wet return.

In neither the one-pipe or two-pipe system is it necessary to pass all the returns through the regulator. A typical set of returns is selected most convenient to the particular layout.

In the one-pipe system the other returns may come back wet, or, where conditions require, overhead and then drop to the wet return.

In the two-pipe system the other returns come back overhead, in groups, vented by means of a thermo-float air valve and then drop to a wet return through which the condensation returns to the boiler.

The fractional distribution inlet valve (Fig. 4) consists of a packless valve with an adjustable key-hole-shaped orifice in both the body and the union. By rotation of the union piece any desired opening may be obtained. The pressure drop through this valve is 2 oz. at maximum rating. Higher pressure drops are obtainable by decreasing the area of the orifice.

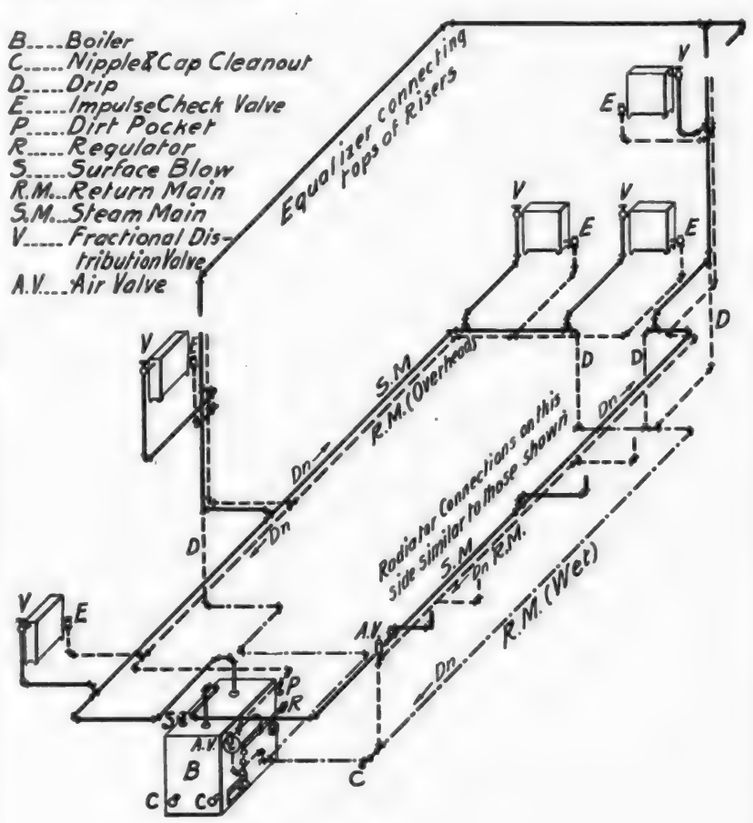
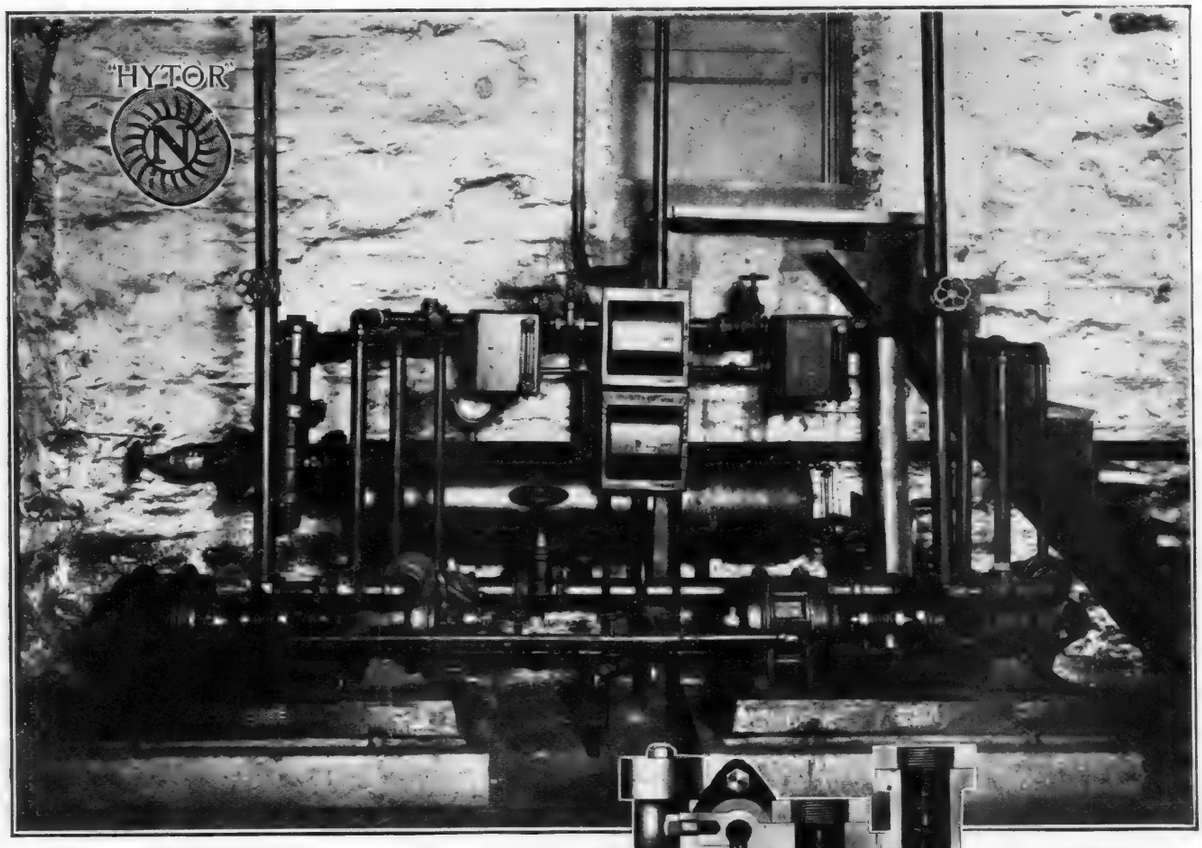


FIG. 2.

(*Continued on Data Sheet No. 132-FF.*)

Copies of this Data Sheet, printed separately, 5 cents each.

EFFICIENT HEATING
demands the JENNINGS PUMP



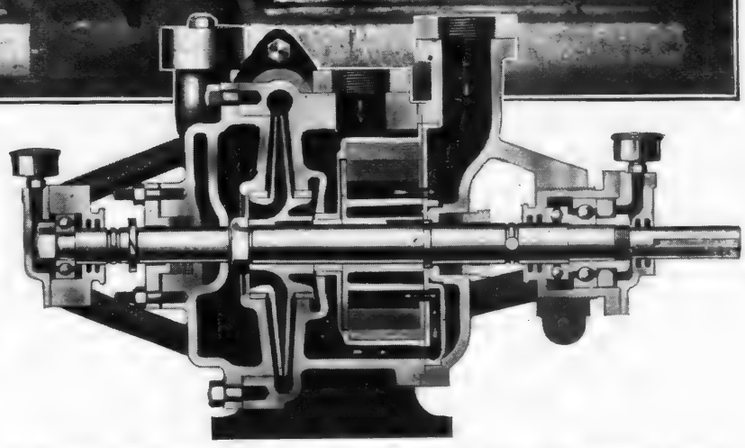
Duplex "D" Unit Continuous Operation

MONROE SCHOOL

Minneapolis, - - - - Minn.

Capacity each pump 40,000 square feet direct radiation; air capacity 25 cubic feet per minute in addition to a water capacity of 60 gallons per minute.

The motors are only three horse power.



THE Jennings Pump consists of two independent turbine units, an air pump and a water pump. As each material is handled separately, the boiler pressure is against the water only. The air and vapor, approximately four-fifths of the volume handled, are delivered to the atmosphere without back pressure. The saving in horsepower is over fifty per cent. In other words, the current to operate is cut in half.

Because of its compact design, this equipment can be installed in less than one-third the space necessary with other apparatus. All interior parts are bronze, supported on annular ball bearings mounted outside of casing. Moving parts revolve without contact.

A quiet, reliable operation with minimum expense for repairs and without annoyance because of shut-downs, is assured if the Jennings Pump is installed on your Vacuum Heating System.

There are many other reasons why the Jennings Pump is being installed in practically all of the important buildings. Bulletin No. 15 gives them in detail. Write for it.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONN., U S. A

TRADE AND MISCELLANEOUS NOTES

Coming Events.

January 24-26, 1921.—Annual meeting of the American Society of Heating and Ventilating Engineers, in New York. Headquarters at the Hotel Pennsylvania, Seventh Avenue and 33rd Street. Secretary, C. W. Obert, 29 West 39th Street, New York.

Miscellaneous Notes.

Cleveland, O.—The American Building Exposition, with which the new Cleveland Auditorium will be opened, will run from January 4 to 14, 1922. The number and variety of the exhibits already arranged for make it evident that Cleveland will be to a degree the center of the building industry of the country during that period. In addition to the exhibits the architects' organizations are planning a series of lectures on house and building design. A special exhibit will be prepared by the Heating and Piping Contractors' Association of Cleveland.

National Founders Association held its 25th annual convention in New York, November 16-17.

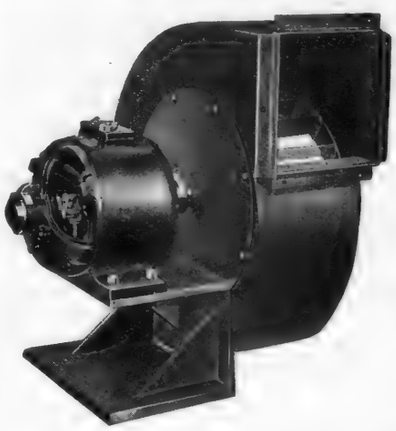
New York's fourth annual "Own Your Home" Exposition will be held April 22-30, 1922, in the 69th Regiment Armory, New York, at Lexington Avenue and 25th Street. Among the various committees that are being formed at the present time to handle the different classes of exhibits are: Architectural, Dwight James Baum; building and finance, Edward P. Doyle, secretary Mayor's Committee on Housing; building materials, Frank F. Pellett, district sales manager, W. B. Abbey, Inc.; heating and ventilating, D. Rait Richardson, president Richardson & Boynton Co.; sanitation committee, David Deigan, acting president New York Master Plumbers' Association. It is stated that every phase of home planning, financing, building, equipping, furnishing and landscaping will be shown on the exposition floor, while the downtown location of the show is expected to draw larger crowds than ever before.

National Thrift Week is scheduled for January 17-23 inclusive, 1922. The various slogans will be: 17th, thrift day (Benjamin Franklin's birthday); 18th, budget day; 19th, life insurance day; 20th, "own your home" day; 21st, "pay your bills promptly" day; 22nd, "share with others" day; 23rd, "make a will" day.

Buffalo, N. Y.—At a recent meeting of the fan manufacturers in Buffalo subscriptions to the amount of $15,000 a year for the next five years were made to the Research Laboratory of the American Society of Heating and Ventilating Engineers. Those who addressed the meeting urging support of the bureau included Dean F. Paul Anderson, director of the Research Laboratory; F. R. Still, of the American Blower Company and J. I. Lyle, of the Carrier Engineering Corporation.

Red Cross Roll Call for 1922 set a mark of $500,000 to be raised by the engineering and building interests of New York City through dollar memberships. Joseph Geoghegan, of Gillis & Geoghegan, represented the subcommittee of heating contractors.

Building Operations for October were 25% ahead of last year, according to the F. W. Dodge Company's review of building activity. The figures



Regardless of Weather Conditions, There Is Always a Demand for Adequate and Efficient Ventilating Equipment. This Demand Is Not Affected by the Change in Seasons, as Fans and Blowers Are Just as Urgently Required During the Fall and Winter Months as During the Summer Season.

Autovent Fan and Blower Products

Are used extensively on many different applications, such as for heating, drying and exhausting; for ventilation in schools, churches, hotels, restaurants, and in fact, every place where people congregate for either work or play

(Patented)

If you have not considered the wonderful sales possibilities of the Autovent Fan and Blower line, now is the time to get full particulars regarding the progressive merchandizing policy that we have inaugurated.

Our detailed plan of how we are co-operating with heating and ventilating contractors, in assisting them to develop a highly profitable volume of business through the sale of Autovent Fans and Uniblade Blowers will be forwarded on receipt of your request.

AUTOVENT FAN AND BLOWER CO.

Formerly
BATTERMAN-TRUITT COMPANY

Branch Offices in All Principal Cities

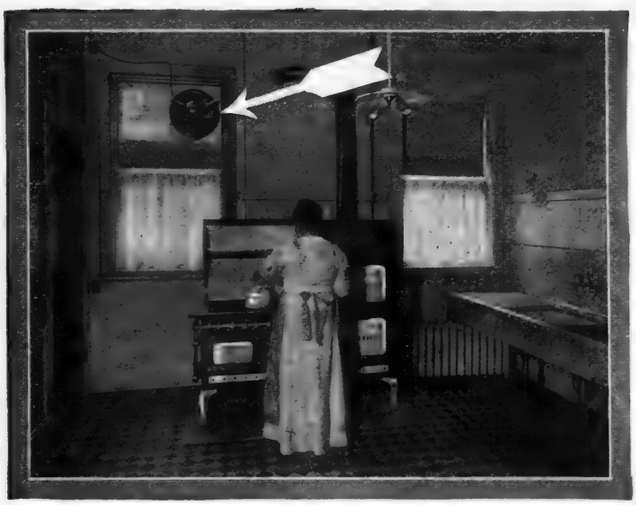
General Offices and Works, 730-738 W. Monroe St., Chicago

of contracts awarded in the 27 northeastern States were $22,480,000, 25% above the figures for October, 1920. There was a marked increase in activity in New England during October. Other sections showed moderate declines. Residential building still leads, amounting to $89,650,000 in October or 40% of the total construction. The New England figures of $21,702,000 were 35% over September and 20% over October, 1920. In New York State and northern New Jersey the figures of $75,225,000 were the largest monthly total since April, 1920, with the exception of September. The middle Atlantic States, with a total of $33,616,000 more than doubled the figures for October, 1920 and went 10% under the September, 1921, total. The Pittsburgh district, with a total of $33,932,000 was 7% under October, 1920 and 17% under September, 1921. In the central West the figures of $51,085,000 were 3% greater than October, 1920 and 12% under September, 1921. The Northwest figures of $6,919,000 were practically the same as those for September.

St. Louis, Mo.—25,000 of the city's public school population, it is stated, are now receiving ozone-freshened air with such results, as noted by the twelve licensed physicians on the school board's staff, in the Department of Hygiene, that the decision has been made to equip all of the 140 buildings with ozone apparatus, as fast as construction can be changed to premit recirculation of the air. It is further announced that plans are being made for a building for anaemic and backward children in which the open-window treatment wil be supplanted by a system using ozone-freshened, recirculated air.

American Society of Mechanical Engineers has elected officers as follows: President, Dexter S. Kimbal, Ithaca, N. Y.; vice-presidents, Colonel E. A. Deeds, Dayton, O., Robert Sibley, San Francisco, Cal. and L. E. Strothman, Milwaukee, Wis.; managers, Sherwood F. Jeter, Hartford, Conn., Horace P. Liversidge, Philadelphia and Hollis P. Porter, Tulsa, Okla.; treasurer, William H. Wiley, New York; manager (one year to fill unexpired term of D. S. Kimball) Walter S. Finlay, Jr., New York.

Central Supply Association elected



Three times a day---during morning, noon, and evening cooking periods---21 times a week or over a thousand times a year an

ILG ELECTRIC VENTILATING COMPANY ILGAIR CHICAGO, ILL.

Kitchen Ventilator will keep cooking odors and greasy fumes from circulating through every room.

The Ilgair is the most useful of Household Appliances. It costs less despite the fact that it is used the most. Send for descriptive circular, also literature on Ilg Self Cooled Motor Fans for other uses.

With the closing of windows and doors during cold weather "Ventilation through the Kitchen" will be eagerly sought by every home owner. Contractors can sell many Ilgairs right now.

HIGH EFFICIENCY TRADE ILG MARK VENTILATING MACHINERY

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MARSH

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VALVES

Quick Opening

Note General Lines Carefully

The **ONLY Packless** and **Modulated** Valves in which the **Packless Feature,** although a **positive seal within itself** and **practically indestructible,** is, through a packing cushion and a very heavy special spring, **automatically re-enforced,** providing **two or double, independent, positive,** bonnet seals at **all times.**

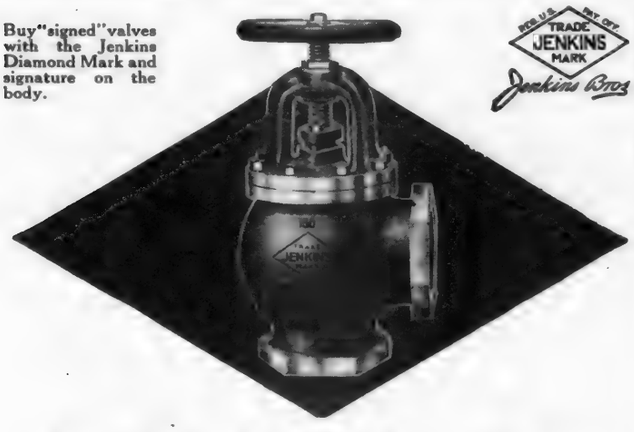
These valves will withstand high pressures and, therefore, are of **superior value** for **vacuum** and **low pressure service.**

We specialize on high grade Radiator Valves and furnish the largest line of any company in the business.

Printed matter and prices on application

MARSH VALVE CO., Erie, Pa.

Buy "signed" valves with the Jenkins Diamond Mark and signature on the body.



TRADE JENKINS MARK

Jenkins Bros

Iron Body, Angle Valve, with yoke

Fig. 143, standard pattern sizes 2 to 12 inches, suitable for 150 pounds steam, 250 pounds water; 14 inches and above, 100 pounds steam, 125 pounds water. Made screwed, as shown, or flanged. Fitted with Jenkins Renewable Disc. Accessible stuffing box which can be repacked when valve is wide open and under pressure.

At supply houses everywhere

JENKINS BROS.

New York Boston Philadelphia Chicago
Montreal London Havana

FACTORIES: Bridgeport, Conn.; Elizabeth, N. J.; Montreal, Canada.

Jenkins Valves

SINCE 1864

Here's the simplest Radiator Trap

Read how a hollow, floating copper ball makes the Johns-Manville Radiator Trap a profitable one for you to install.

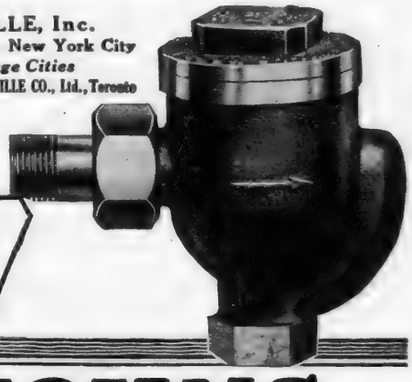
THIS is a cross-section of a Johns-Manville Radiator Trap. The hollow copper ball floats in the trap; rolling up and uncovering the outlet when water and air are to be discharged; rolling back and covering the outlet to prevent the loss of steam when the line is clear.

You can install the Johns-Manville Radiator Trap on pressure or vacuum systems with the certainty that it will always work, without the loss of steam, regardless of temperatures.

You can see there's nothing to adjust, nothing for unauthorized persons to tamper with, nothing to hold up your payments.

A trap like this is worth your careful investigation — ask the nearest Johns-Manville branch about it.

JOHNS-MANVILLE, Inc.
Madison Ave., at 41st St., New York City
Branches in 60 Large Cities
For Canada: CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto



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Asbestos

and its allied products

JOHNS-MANVILLE
Serves in Conservation

Heat Insulations, High Temperature Cements, Asbestos Roofings, Packings, Brake Linings, Fire Prevention Products

JOHNS-MANVILLE Radiator Trap

the following officers at its 27th annual meeting in Chicago, October 26: President, E. C. Garrity, National Plumbing & Heating Co., Chicago; first vice-president, E. I. Leighton, Leighton Supply Co., Fort Dodge, Ia.; second vice-president, M. M. Cochran, Cochran-Sargent Co., St. Paul, Minn.; treasurer, Edward F. Niedecken, Hoffman & Billings Mfg. Co., Milwaukee, Wis.; secretary, Paul Blatchford, Chicago. A atmosphere of optimism prevailed throughout the meeting as the result of numerous reports of greatly improved business conditions. The recent rush of orders, it was stated, resulted in a shortage in many lines, so that manufacturing has been speeded up considerably. The principal addresses at the meeting were delivered by William J. Woolley, secretary-manager of the National Trade Extension Bureau, resulting in a vote of endorsement of the bureau's work, and by Harry A. Wheeler, vice-president of the Union Trust Company of Chicago who spoke on "Present Business and Financial Situation and Bearing of the World Problems on Our Domestic Situation."

American Gas Association, as the result of a recent survey, has issued a statement that:

Gas furnishes the cooking heat, and in many cases illumination, in the homes of over 49,000,000 citizens.

Communities served with gas number 4,600 and meters 8,580,000 the gas mains totaling 68,300 miles.

To make the gas consumed by households and industry last year required 8,500,000 tons of bituminous coal, 2,000,000 tons of anthracite coal 1,500,000 tons of coke, and 960,000,000 gallons of oil.

There are now 7,000,000 gas-burning cooking appliances in American homes, gas water heaters number approximately 1,500,000 and gas heaters nearly 1,000,000.

Hotels, clubs, restaurants and institutions using gas for all cooking number 71,490, while those using it in part number 13,776.

The tremendous use of gas for industrial purposes is seen in the fact that 25% of the nation's consumption is now by manufacturing concerns, it being used in over 1,200 different processes.

American Institute of Chemical Engineers held its fourteenth annual meeting in Baltimore, Md., December 6-9. The sessions were largely taken up with the relation of chemistry and chemical engineering to warfare.

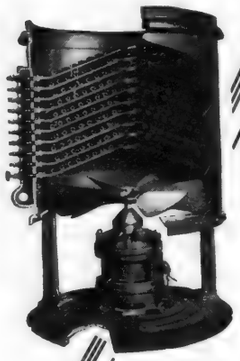
Standardization in the Building Industry in accordance with the suggestions of the new Division of Building and Housing recently established in the Department of Commerce, will, if adopted, result in a cut of $600 in the construction costs of the average small house and a reduction of 20% in practically all bills for plumbing equipment. This estimate was given by F. M. Feiker, special assistant to Herbert Hoover in a speech before the National Editorial Conference in Chicago, October 24. The construction saving would depend largely upon the national adoption of standardized code regulations with regard to fire-walls, while the saving in plumbing equipment would result from the simplification of plumbing specifications and regulations.

Associated General Contractors of America has begun the publication of a weekly statistical report service for general contractors called *Index*. The first number was dated October 8. The information presented is intended to show at a glance the most significant developments in construction. The service, it is added, is available to any firm interested in construction. The association's headquarters are in Washington, D. C., at 1038 Munsey Building.

Kansas City, Mo.—"A Better Homes and Building Exhibit" has been arranged by the Kansas City Real Estate Board, to be held in that city February 6-11, 1922. The local chapter of the American Institute of Architects will co-operate with the board in preparing the exhibits.

Chicago, Ill.—In connection with the opening of the heating season in Chicago, the Commissioner of Health is calling fresh attention to the requirements for furnishing the proper amount of heat in apartments and offers the following suggestions which are addressed to owners and tenants:

1. Tenants in all cases should notify the owner or his agent of failure to be



UNIFORM HEATING

is accomplished by removing the cold air from the floor line and replacing it by warmer air that naturally tends to go towards the ceiling.

The Bayley B.T.U.

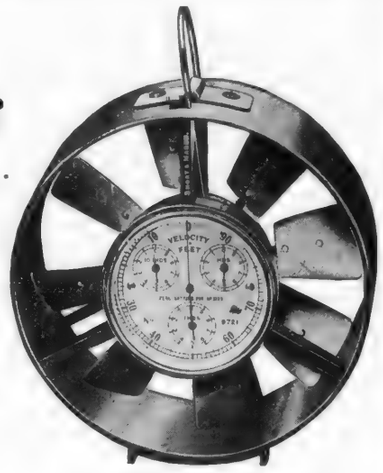
distributes heat evenly by means of an electrically driven fan, installed under a series of tempering coils. The fan forces air through the coils and keeps up a constant circulation of tempered air throughout the room. It is made of iron and steel throughout, requires no distribution ducts; no holes through fire walls or partitions, can be installed anywhere by simply setting on the floor and connecting steam and return piping and wiring to motor. Easily moved from one location to another.

Send for B. T. U. Bulletin today

Dept. E, Bayley Mfg. Co.
732 Greenbush St., Milwaukee, Wis.

Tycos
Anemometer

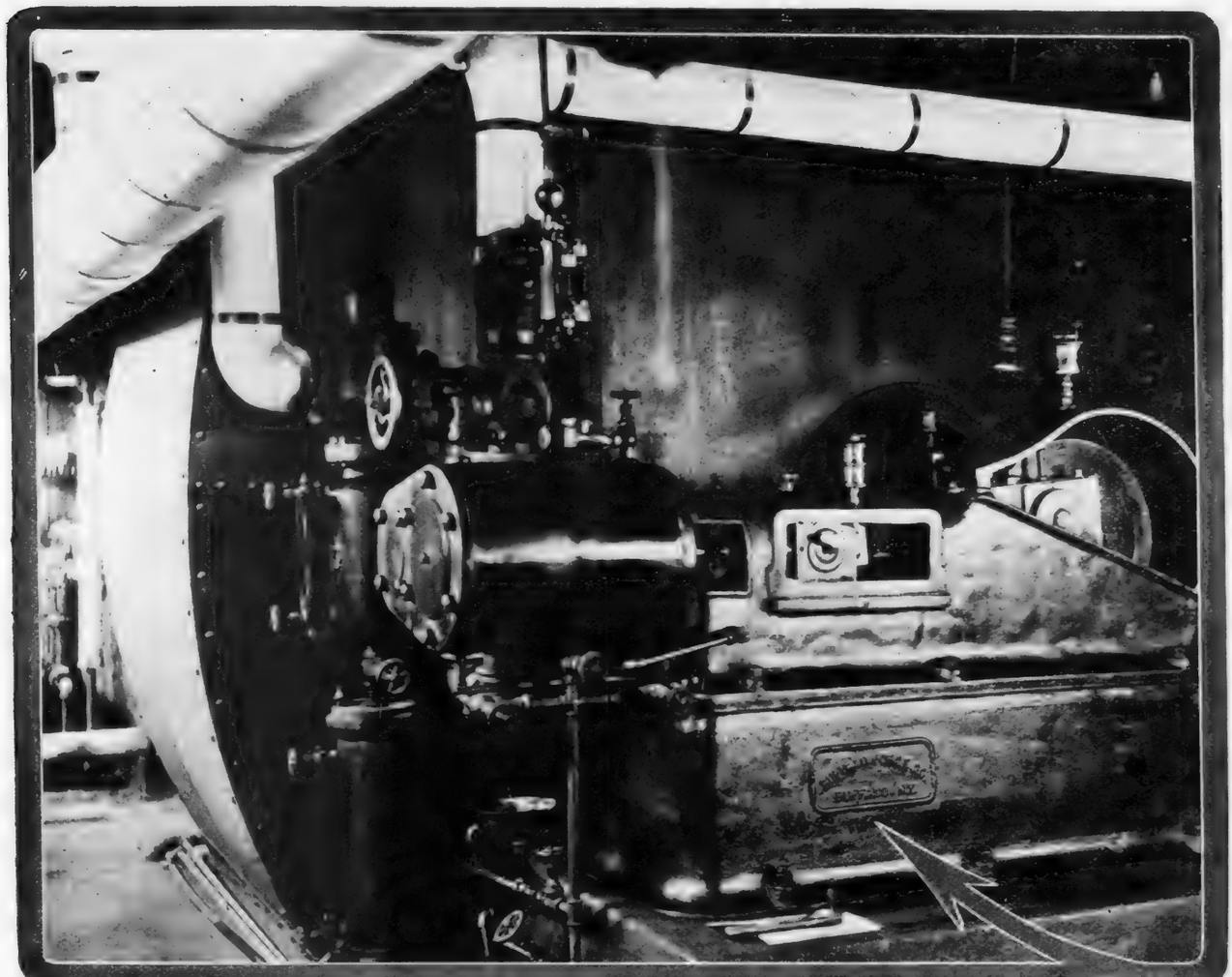
Handy
Sturdy
Dependable



Measures Air Velocities

from 100 to 3,000 feet per minute. Essential if you desire unquestioned efficiency in heating and ventilating.

Taylor Instrument Companies
ROCHESTER, N. Y.
There's a *Tycos* or *Taylor* Temperature Instrument for every purpose
827



19 YEARS SERVICE

The drying of crayons is one that calls for the highest efficiency of the mechanical equipment.

The American Crayon Company have kept the "Old Faithful" brand of crayons and chalks at the front of the field since 1835.

We point with pride to the Buffalo Fan and Engine that has typified "Old Faithful" by its nineteen years of continuous and satisfactory service at the American Crayon Company. This is summed up by a recent report which states.

"We like it because it gives good service"

A line to Dept. 36 will bring further evidences of Buffalo Service.

Buffalo Forge Company
BUFFALO, N. Y.

"Buffalo"

given heat before complaining to the Deparment of Health.

2. Complaints should not be made without good and sufficient cause.

3. Landlords and their agents should recognize the importance of an adequate heat supply and see to it that their janitors are not careless or negligent in supplying it.

4. Landlords and their agents should give prompt attention to notices from the Department of Health and also should inform the Department of their compliance with such notices.

5. Both owners and tenants should try to apply in a sane and practical way the Golden Rule of doing unto others as you would have others do unto you.

Billings, Mont.—J. R. Hartley of Billings has been appointed a State boiler inspector to succeed Richard Moran. Montana has three boiler inspectors; Mr. Hartley will handle the Billings district.

Special Libraries Directory, edited by Dorsey W. Hyde Jr. president of the Special Libraries Association and containing the results of a recent survey made by the association contains the interesting statement that the engineering profession has taken a leading part in the development of research and informational facilities. As a result of the investigation over 1300 special libraries were discovered, many of which are largely concerned with engineering, technology, electricity, chemistry and industrial management. The headquarters of the association are in the Mills Building, Washington, D. C.

Indianapolis, Ind.—Under the auspices of August Buschmann & Sons, of Indianapolis, Ind., dealers in heating and plumbing supplies, something new has been started in the shape of a deferred-payment plan of selling heating and plumbing apparatus. Double-page advertisements were recently published in the Indianapolis papers announcing the scheme. In explaining the "Buschmann Payment Plan," it was stated that arrangements could now be made with practically every responsible heating and plumbing contractor in the city to install anything needed in the way of heating and plumbing apparatus. The principal feature of the plan is the use of trade acceptances.

Eastern Supply Association re-elected all of its officers at its annual meeting held in New York, October 12, as follows: President, A. M. Maddock, Trenton, N. J.; first vice-president, Frank W. Hubbard, Boston; second vice-president, George E. Keenan, Bayonne, N. J.; treasurer, Martin Behrer, New York; secretary Frank S. Hanley, New York. The principal speakers were William J. Woolley, secretary-manager of the National Trade Extension Bureau; Thomas S. Holden, statistician of the F. W. Dodge Company, who spoke on "Up-to-the-Minute Business Statistics," in which he painted a bright picture of business prospects; Arthur R. Marsh, editor of the *Economic World,* whose subject was "The Necessary Stages of the Return to Business Prosperity"; and G. A. Fromm, credit manager of the American Radiator Company who spoke on "Timely Credits."

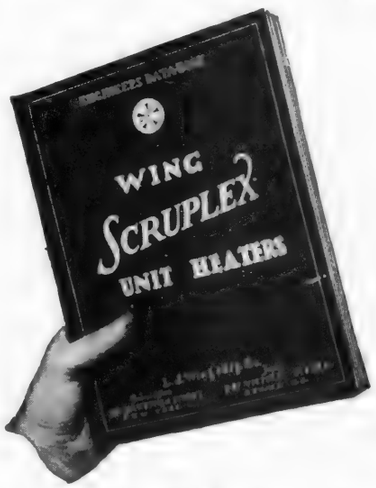
International Textile Exposition, held in Mechanics Hall, Boston, October 31-November 5, under the auspices of the Textile Exhibitors' Association, attracted exhibits from a large number of firms connected with the heating and ventilating industry. Among those noticed were the exhibits of the American Moistening Co., Boston, (humidifiers, compressor pumps, pipe and fittings); Westinghouse Electric & Mfg. Co., East Pittsburgh, (motors, dynamos, etc.); Carrier Engineering Corporation, Newark, N. J., (complete Carrier air conditioning equipment in operation under automatic control); B. F. Perkins & Son, Inc., Holyoke, Mass., (ventilating disc fans, etc.); Parks-Cramer Co., Fitchburg, Mass., (Triplex pump and motor, air conditioning apparatus, humidifier heads, etc.); Grinnell Co., Boston, (complete engineering and construction service, automatic sprinkler, industrial piping, heating and power equipment, fittings, pipes and valves); Sarco Co., Inc., New York, (Sarco self-contained temperature regulators, thermostatic steam traps, radiator traps, indicating thermometers and self-cleaning strainers); Allen Engineering Co., Boston, (power plant equipment); Nash Engineering Co., So. Norwalk, Conn.; American Steam Gauge & Valve Co., Boston, (American steam gauges, clocks, counters, pop safety and relief

7
MASSACHUSETTS
FANS
INSTALLED IN THIS BUILDING

·ASTOR·TRUST·CO·BLDG·NEW·YORK·CITY·

MASSACHUSETTS BLOWER CO., Watertown, Mass.
Branches in 20 Principal Cities

This Book Contains Valuable Data on Economical Heating



WING-SCRUPLEX UNIT HEATERS
REG. U.S. PAT. OFF.

by confining the heat to the working area, save both coal and installation cost. They present the most economical method of heating and ventilating Industrial Buildings.

Send for your copy NOW, and learn how to save some of that valuable coal.

L. J. Wing Mfg. Co.

Fans and Blowers (All Types)
Hudson & 13th St.,

Damper Regulators
Small Turbines
New York, N. Y.

BUILDINGS OF THE MICHIGAN CARTON CO., Battle Creek, Mich.
H. D. Prather, Consulting Engineer, Cleveland, O.

The Michigan Carton Company

Is one of the country's largest producers of cardboard cartons. Their plant is a model in the paper industry.

As a prominent factor

in the production of the high quality cartons they make, Sirocco equipment does full duty throughout their plant.

"Sirocco"
TRADE MARK.

In the power plant

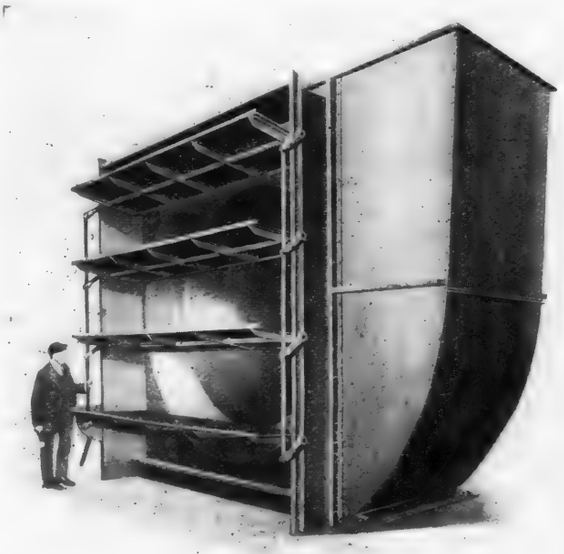
a Sirocco Induced Draft Fan produces draft for the 2700 Horse Power Boilers. In the machine room two enormous paper machines are equipped with Sirocco Fans for carrying away the steam from the drying web of paper and maintaining the proper circulation of air.

Wherever there is

a heating and ventilating problem to be considered there is a type of Sirocco fan, blower, engine or air washer to fill the need.

Heating and Ventilating

engineers are invited to get in touch with one of our offices on problems to be considered along the above lines.



Inlet side of Induced draft fan for Michigan Carton Co., Battle Creek, Mich.

American Blower Company

Detroit, Mich.

valves, and American Ideal steam traps); Petroleum Heat and Power Co., Boston, (a complete low-pressure oil burning outfit and a complete high-pressure outfit); Johns-Manville Co., Inc., of Massachusetts, (machine for chilling water and working model of an insulated cloth dryer); Mason Regulator, Dorchester, Mass., (reducing valves, pump governors, balanced valves and draft regulators); The Foxboro Co., Foxboro, Mass., (indicating and recording instruments and automatic temperature controllers); Widger & Miller Co., Boston, (pumps, valves and boiler models); Coppus Engineering & Equipment Co., Worcester, Mass., (Coppus "Vano" blowers); Pratt & Cady Co., Inc., Boston; Walworth Mfg. Co., Boston, (Walworth brass and iron body valves, cast and malleable iron fittings); A. W. Cash Co., Decatur, Ill., (pressure-reducing and regulating valves, valve specialties, pump governors, fan engine regulators, relief valves, etc.); the V. D. Anderson Co., Boston, (steam traps, steam and oil separators, air traps and copper floats); Taylor Instrument Cos., Boston, (thermometers, hydrometers, recording and indicating thermometers, pressure regulators, pyrometers, etc.); Foster Engineering Co., Boston, (valve specialties for steam, air, water, etc.); Crane Co., Boston, (miscellaneous power plant piping, with valves, fittings and steam specialties); and C. J. Tagliabue Co., Brooklyn, N. Y., (Tag self-operating temperature controllers, Tag Roesch time-temperature controllers, Tag self-contained humidity controllers, indicating and recording thermometers, etc.).

Manufacturer's Notes.

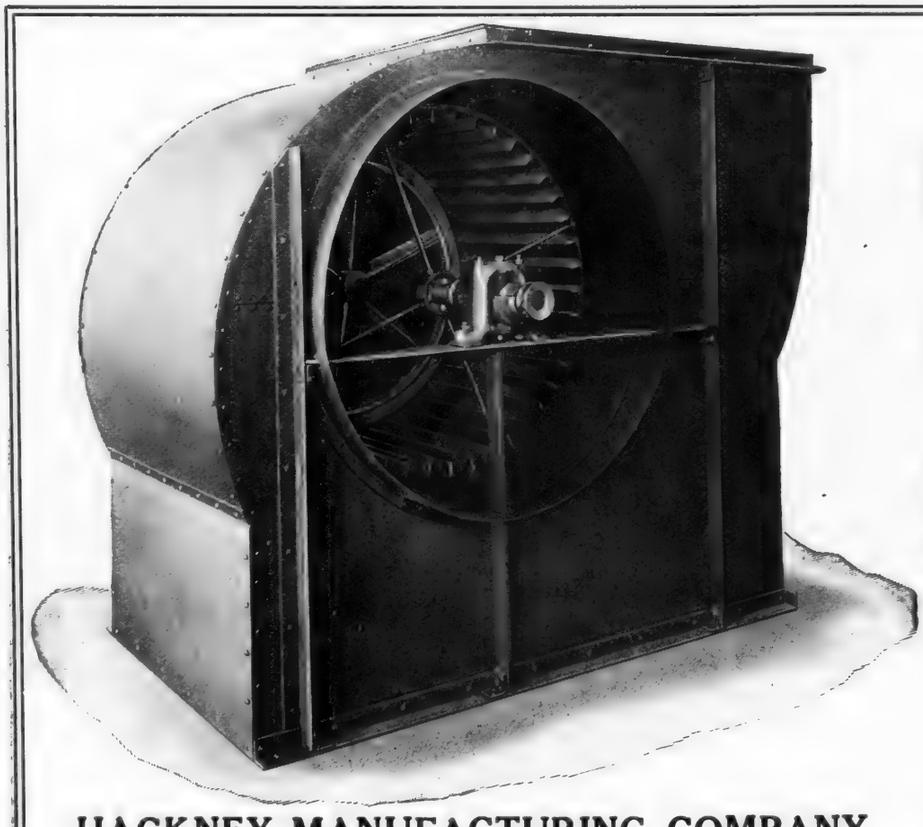
American District Steam Co., North Tonawanda, N. Y., announces the appointment of Walter S. Hillis as general sales manager for the company. Mr. Hillis was for six years manager of the Chicago branch of the United States Radiator Corporation. He succeeds B. A. Lewis, formerly advertising and sales manager, merchandise division. Mr. Lewis leaves the company after 19 years' service to open a sales office in Buffalo specializing in heating equipment, including the products of the American District Steam Company.

Crane Co., Chicago Ill., has awarded the contract for the erection of a new branch plant in Davenport Ia., to cost $85,000. The location is on West Second Street and the building will be three stories high. The company has also acquired the plant of the Glenmore Lubricant Co., in Lima, O., which will be used as a distributing station. William T. Cotter is manager of the company's present branch in Davenport, at 624 East 4th Street.

Dahlquist Mfg. Co., Boston, Mass., reports a decided improvement in business as evidenced by the following recent orders: two 800-gal. copper boilers for the John Hancock Life Insurance Building, Boston, (W. G. Cornell Co., contractors); one 750-gal. copper boiler for St. Mary's Hospital, Waterbury, Conn. (M. J. Daly & Sons contractors); one 350-gal. copper boiler for the Manchester High School, Manchester, N. H. (J. H. Stevens & Co., contractors); one 350-gal copper boiler for the Lowell High School, Lowell, Mass (Hurley & Co., Boston, contractors); one 500-gal. copper boiler for the Greenwood Memorial Building, Gardiner, Mass.; and four 250-gal. copper boilers for new apartment houses at 12, 14, and 16 East 89th Street, New York (W. G. Cornell Co., contractors).

Republic Boiler & Radiator Co., Baltimore, Md., it is announced, will shortly begin to manufacture a full line of heating apparatus at its Baltimore plant. The president of the new company is E. L. Stock, who is also president of E. L. Stock & Company and vice-president of the Hart & Crouse Company. The plant, which is being organized on a 50-ton per day basis, will be under the direction of William C. McKeown, formerly with the American Radiator Company and with Hart & Crouse Company. The Republic plant in Baltimore was built under government supervision and has been remodeled for the production of heating apparatus.

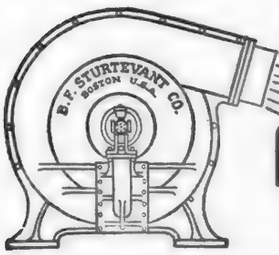
M. W. Kellogg Co., Jersey City, N. J., manufacturer of pipe, fittings, etc., is completing plans for a new three-story building.



CAREFUL
CONSERVATIVE
Engineers
and
Architects
ARE SPECIFYING
Hackney
"V" Blade
Blowers

Effectiveness
AND
Rigid Construction
The Reason

HACKNEY MANUFACTURING COMPANY
SAINT PAUL, MINN.



Sturtevant

REG. U.S. PAT. OFF.

PUTS AIR TO WORK

Ventilation and Decoration

IT is not often that the ventilating scheme of a building is the determining factor in its decoration, yet here is an example where the ventilating requirements have been frankly met and a notable interior achieved.

This large assembly room in the Rochester Chamber of Commerce is fully ventilated with

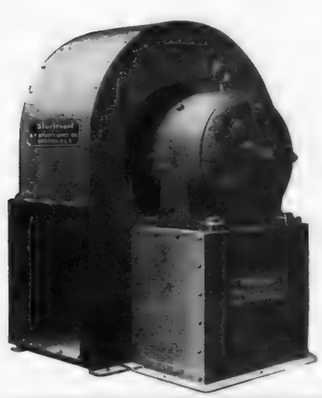
Sturtevant Equipment

The warm air enters through attractive grilles in the oak paneling on the lower walls and the vitiated air is drawn through the perforated plaster ceiling. This combination of utility with beauty meets all architectural demands and develops the full efficiency of the ventilating system.

Illustrations show details of ventilating perforations in ceiling of Assembly Room in Chamber of Commerce, Rochester, N. Y. Claude Bragdon and Foster & Gade, Associated Architects

DETAIL OF CENTER OF CEILING

DETAIL OF SIDE OF CEILING



B. F. STURTEVANT COMPANY

HYDE PARK, BOSTON, MASS.

STURTEVANT BRANCH OFFICES

ATLANTA, GA.
306 Walton Bldg.
BOSTON MASS.
555 Mass. Trust Bldg.
BUFFALO, N. Y.
100 Bedford Ave.
CHICAGO, ILL.
530 So. Clinton St.
CINCINNATI, OHIO
610 Fourth National Bank Bldg.
CLEVELAND, OHIO
330 Guardian Bldg.
DALLAS, TEXAS
3411 Knight St.
DETROIT, MICH.
406 Marquette Bldg.
HARTFORD, CONN.
36 Pearl St.
KANSAS CITY, MO.
707 Mutual Bldg.
LOS ANGELES, CALIF.
411 Hollingsworth Bldg.
MINNEAPOLIS, MINN
804 Met. Life Bldg.
NEW YORK, N. Y.
52 Vanderbilt Ave.
PHILADELPHIA, PA.
135 No. Third St
PITTSBURGH, PA.
711 Park Bldg.
ROCHESTER, N. Y.
1024 Granite Bldg.
ST. LOUIS, MO.
2086 R'y Exchange Bldg.
SALT LAKE CITY, UTAH
818 McIntyre Bldg.
SAN FRANCISCO, CALIF
759 Monadnock Bldg.
SEATTLE, WASH.
1105-1106 White Bldg.
WASHINGTON, D. C.
1006 Loan & Trust Bldg.
B. F. STURTEVANT CO OF CANADA, LTD.
GALT, ONT.
MONTREAL
404 New Birks Bldg.
TORONTO
210 Lumsden Bldg.

American Radiator Co., Chicago, Ill., it is announced, has acquired an important interest in the Fox Furnace Co., Elyria, O., manufacturer of the Sunbeam warm-air furnaces. In entering the field of warm-air furnace manufacturing, it is added, the American Radiator Company "hopes to lend a constructive influence in advancing the interests of modern heating in all its phases." The American Radiator Company has been engaged in the manufacture of heating apparatus for over 30 years, the company's products including apparatus for heating by hot water, steam, vapor, oil and gas. Association with the Fox Furnace Company, it is stated, "will round out their line by embracing warm-air heating as a minimum cost product." The Sunbeam warm-air furnaces will continue to be manufactured by the Fox Furnace Company.

Beach-Russ Co., New York, manufacturer of condensation outfits, and return-line vacuum pumps, has moved its general offices to 50 Church Street, New York (Hudson Terminal Building). The company has been located at 220 Broadway, New York, for the past 23 years and is known as one of the oldest manufacturers of vacuum pumps supplying the vacuum steam heating trade.

Central Station Heating Notes.

Bucyrus, O.—A 25-year franchise has been granted by the city council to John R. Boyd for the operation of a central water heating system in Bucyrus, final action being taken by the council November 15. Although the franchise is being taken in the name of Mr. Boyd, it is understood that it will be taken over later by the Ohio Power Company, of which Mr. Boyd is the local manager. The new system is being planned to serve a considerable section of central Bucyrus. It is expected to cost $145,000; work will be started next spring. The franchise stipulates that the first or original section shall be constructed within three years and the city reserves the right to regulate the rates for service at intervals of not less than five years. The "original" section of the system will include a heating main from the present electric power plant south to Charles Street on Sandusky Avenue and from Poplar Street east to East Street on Mansfield Street. From these mains service lines will supply business blocks, hotels, private homes, etc.

Livingston, Mont.—Livingston is to have a central heating plant, according to an announcement made by C. S. Hefferlin. The site of the plant will be on Park Street on lots formerly occupied by the Merchants Hotel. Work on the plant, which will cost $40,000, will start early in the Spring.

New Incorporations.

W. R. Taylor Corporation, Chicago, Ill., capital $5000, to manufacture, heating, ventilating and lighting specialties. Incorporators: W. R. Taylor, R. H. Stoll and T. H. Monaghan. Quarters have been taken at 622 West Monroe Street.

Ford & Manion, Inc., Wilmington, Del., capital $100,000, to manufacture electrical heating equipment and appliances. Incorporators: Joseph J. Ford and Francis T. Manion, both of Wilmington. Representative, Henry R. Isaacs, Equitable Building, Wilmington.

Ansonia No-Fuel System, Inc., New York, capital $1,000,000, to manufacture machinery and appliances for fuel-saving. Representative, Arthur W. Britton, 65 Cedar Street, New York.

Newark Oil Burning Devices Co., Newark, N. J., organized to manufacture oil burners. The new company, of which Thomas Tracy is the head, is located at 78 William Street, Newark.

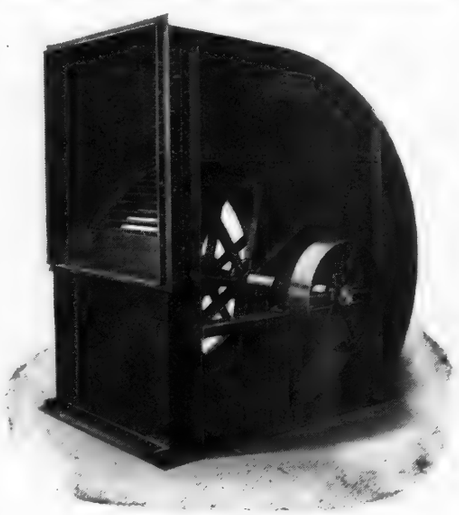
Palmer-McDonald Co., Malden, Mass., capital $90,000, to supply heat deal in heating, plumbing, machinery and auto supplies. President, Weston H. Palmer; treasurer, Charles E. Bourret; directors: the two officers named and John R. McDonald.

New Firms and Business Changes.

Charles F. Hauss, who for many years has represented American heating interests in Rome, Italy, has left for China where he will act for the American Radiator Company in China, Japan, Manchuria and Korea.

Buckeye Multiblade Fans

are made especially for low pressure Heating and Ventilating work. They are giving perfect satisfaction.



CORRECT DESIGN, HEAVY CONSTRUCTION, NOISELESS OPERATION, WORKMANLIKE FINISH, HIGHEST EFFICIENCY.

Our Engineering Department is maintained for the purpose of assisting Engineers, Architects, etc., in planning efficient Heating and Ventilating Systems for all buildings.

THIS DEPARTMENT IS FREE TO YOU

We also manufacture a complete line of Disc, Cone and Steel Plate Fans:

Write Department D

BUCKEYE BLOWER CO.

COLUMBUS, OHIO

Peerless Ventilator

BUILT RIGHT RUN RIGHT

The New York Blower Co.

Chicago, Ill. **La Porte, Ind.**

We manufacture a complete line of fan equipment and appurtenances. By concentrating on this one class of products we are able to make them better every year.

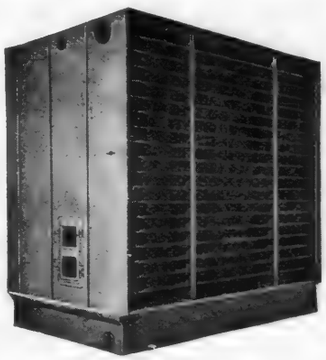
The old fallacy that fan equipment was a luxury is now known to be untrue; it is an economical necessity. We can give actual installations in all kinds of industries where through the wise employment of fan equipment manufacturers have improved the quality of their product, and increased production with a reduction in factory cost.

If you are interested in drying, humidifying, heating, ventilating, mechanical draft, removal of shavings or similar installations, please communicate with us. If we cannot honestly prove facts to you showing the benefits that will follow from an installation for your special problem, we will frankly so state.

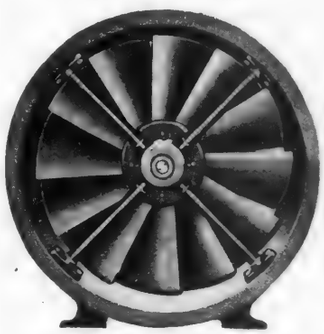
The New York Blower Co.

Chicago, Ill. **La Porte, Ind.**

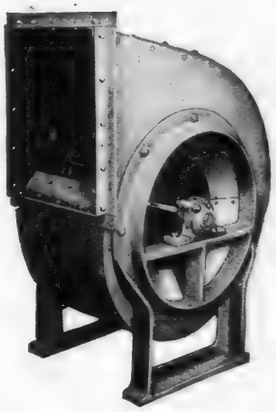
Branch Offices in Principal Cities



Peerless Air Washer

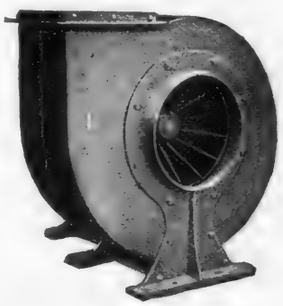


Pulley Driven Disc Fan for Mines

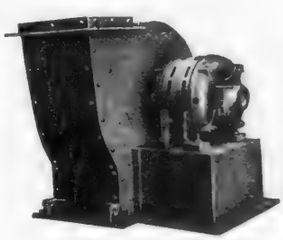


Type "C" Seri-Vane Fan

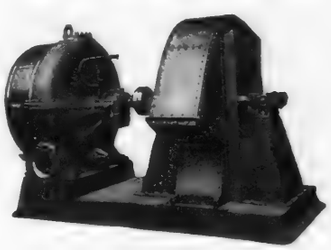
Motor Driven Propeller Fan



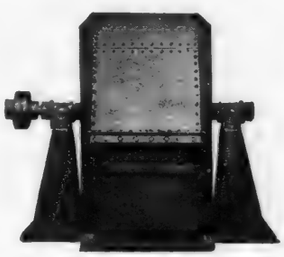
Slow Speed Planing Mill Exhauster



High Speed Type "C" Seri-Vane Fan



High Pressure Blower Direct Connected to Turbine



Stoker Fan

Stovel and Brinkerhoff is the title of a new firm of consulting engineers, composed of R. W. Stovel and H. A. Brinkerhoff. The firm will specialize in investigations and reports on power and manufacturing plants, in addition to the design, construction and equipment of such plants. Mr. Stovel rendered important service during the war in the engineering division at the army's principal base in France, being commissioned a lieutenant-colonel. On his return he became connected with Dwight P. Robinson & Company. Mr. Brinkerhoff had charge of the design and construction of the government nitrate plant No. 2 at Muscle Shoals, Ala., and has also recently been connected with Dwight P. Robinson & Co. Both are members of the American Society of Mechanical Engineers. The new firm has opened offices at 136 Liberty Street, New York.

Charles A. Miller Co., Sturgis, Mich., has been purchased by Paul R. Bishop, Fred Leaming and C. W. Vogal, all of Sturgis. The company is capitalized at $200,000 and is the oldest established business in Sturgis. Mr. Miller the retiring head of the company, is also president of the Kalamazoo Sanitary Mfg. Co., Kalamazoo, Mich., to which he will now devote his time. He is succeeded as president of the Charles A. Miller Company by Paul R. Bishop, for the past three years, manager of the company.

Construction Statistics

Bulletin No. 3 of the U. S. Department of Commerce continues its survey of current business, bringing the figures up to October 1. Its tabulation of building contracts awarded, shows a healthy increase over figures for the preceding month in all three items of number, area, and value of projects. The value of September contracts awarded showed an increase over August contracts in the items of business, industrial, residential, public, social and recreational, religious and memorial, and hospital and institutional buildings, while educational buildings, and public works and utilities, fell off slightly in value from August to September. It is significant of the total figures that they show the number of projects for September as well above the number for any other month in 1920 and 1921, while the value of projects for September has not been equalled in any month since June, 1920. This means that the cost of construction has been materially decreased and that both the number of construction contracts and the investment in that field are increasing.

The average value per project for September was $30,200 while the monthly average value per project for 1919 was $31,400. The average value per square foot for September was $5.91 while the monthly average value per square foot for 1919 was $4.66. The average area per project for September was 5120 sq. ft. while the monthly average area per project for 1919 was 6730 sq. ft. These figures suggest that there is not only more work projected at present than was averaged for 1919, but also a better class of work. Table 1 shows the summary of statistics on construction contracts awarded, as given in the survey bulletin, from data furnished by the F. W. Dodge Company.

WANTED

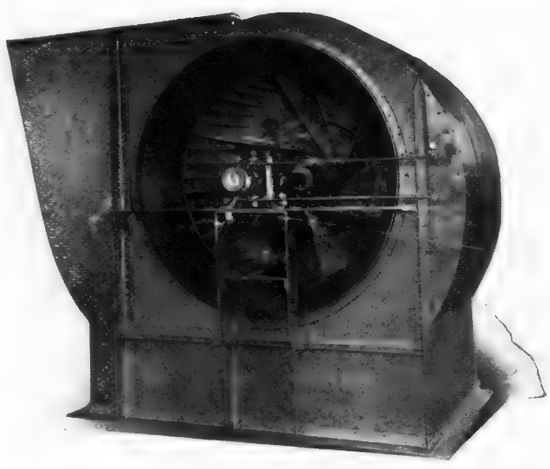
Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

Sales Representative in Detroit, Mich., is prepared to handle a few high-grade heating specialties. Five years' business experience as heating contractor in that city. Manufacturers desiring Detroit representation should address Daniels, care of Heating and Ventilating Magazine.

Position Wanted.—Heating and ventilating engineer have nine years' experience in estimating, designing and superintending erection of all classes of heating and ventilating work, desires position. Address Wilbur, care of Heating and Ventilating Magazine.

For Sale—New No. 2 Toledo stocks and dies complete with ratchet (threads 2½ in. to 4 in.) $37.00 per set. One Beaver stock and die (slightly used), threads 2½ in. to 6-in. pipe, $90.00. Also No. 1 and 2 Trimo cutters, 30% less than market prices. Address Box 150, Granite City, Ill.

LEHIGH



The efficiency and durability of Lehigh Fans makes possible their enviable reputation.

Backed by a highly developed engineering organization and a trained production force, unusual service is given to Lehigh Fan users.

The Lehigh catalog is replete with information and data valuable to fan users. Your copy will be sent upon request.

HERSH BROTHERS CO.

654 Mill Street ALLENTOWN, PA.

1 The Cunard Building
2 The Townhall
3 Bankers' Trust Building
4 Seaboard National Bank

New York's finest are Westinghouse Equipped

Should you select a list of New York's newest and finest buildings you would find all of them users of Westinghouse motors and control.

The four shown here would be on your list, the Cunard Building being one of the most costly structures in the United States and New York's latest skyscraper.

Below are listed a few more of the most recent buildings erected in New York; all are equipped with Westinghouse apparatus.

Each one of these installations is a guarantee of Westinghouse reliability.

Mt. Sinai Hospital	Wurlitzer Bldg.
358 Fifth Avenue Bldg.	Ligget, Winchester, Ley Bldg.
Columbia Trust Bldg.	Guaranty Fifth Avenue Bldg.

Pennsylvania Hotel

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
East Pittsburgh, Pa.

Sales Offices in all Principal American Cities

Westinghouse

HEATING - VENTILATING ELEVATOR & PUMPING EQUIPMENT

Cycloidal
MULTIVANE FANS
TRADE MARK

FULFILL THE OBLIGATIONS OF ENGINEERS AND CONTRACTORS TO THE USER.

Pat'd May 26, 1903

A GENUINE COMBINATION OF EFFICIENCY *AND* DURABILITY

The result of over 40 years of constant experience

A fact that demands your attention:—

"WHEREVER INSTALLED"

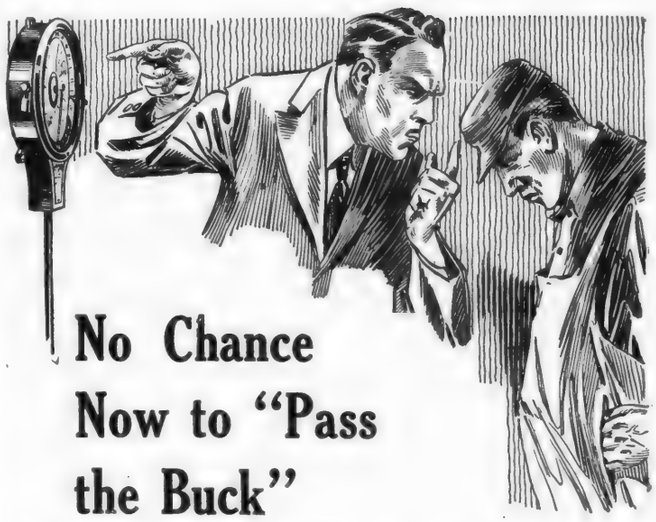
Cycloidal Multivane Fans Receive Unsolicited Praise and Recommendation from Architects, Engineers, Contractors and Users.

Sectional Catalog No. 20 is yours for the asking. Contains Capacity tables, dimensions, etc.

GARDEN CITY FAN CO.
Established 1879
McCormick Bldg. CHICAGO, ILL.

COCHRAN & WRIGHTSON
47 W. 34th St.,
New York City

W. R. SANDERS
212 Empire Bldg.
Detroit, Mich.



No Chance Now to "Pass the Buck"

You can now place the blame on the *exact* man who makes the mistake when goods are ruined or other damage occurs as a result of not maintaining correct temperature. For, by installing a Columbia Recording Thermometer with the new *Time Punch* attachment, you have an automatic watchman that not only unerringly points out any carelessness or neglect, but also *pins down the responsibility and leaves no loophole for alibis or excuses.*

The chart gives a continuous day-and-night record of the temperature itself. But that alone isn't enough—you also want to know whether the temperature has been regularly inspected and undue variations promptly and properly corrected. And this the Time Punch attachment tells when you use

Columbia
Recording Thermometers
With TIME PUNCH

The operator simply pushes a button when making each inspection, and the exact time of the inspection is immediately recorded on the edge of the dial, while the temperature chart shows the temperature at that particular minute. Thus, you get the whole story in an indisputable form.

If the operator fails to make an inspection at proper intervals, then the failure is shown by a blank.

Columbia Recording Thermometers (also Recording Gauges and Tachometers) with the new Time Punch attachment cost no more than an ordinary recorder alone—you get an extra check on temperature control at no extra cost. And it's a check that works both ways—the concientious operator will take pride in having the record of his faithfulness always in evidence, while the careless or lazy operator will immediately brace up and try to avoid a bad record.

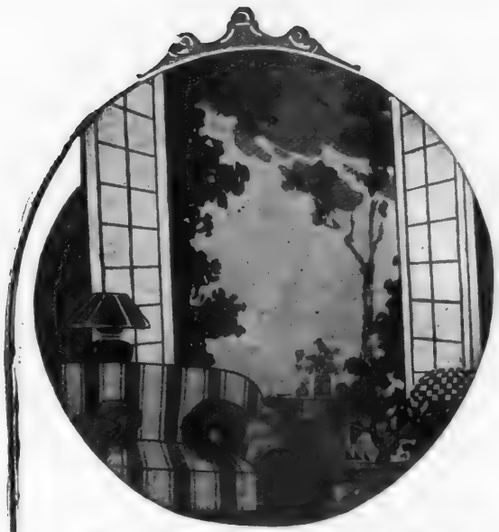
Catalog H-4 gives full information.

A Copy free on request.

THE Schaeffer & Budenberg MFG. CO.

Brooklyn, N. Y.

Atlanta
Chicago
Detroit
Los Angeles
Philadelphia
Pittsburgh
San Francisco
Washington
Toronto



EVERYTHING FOR THE HOME
ON EXHIBITION

America's Second

HOME BEAUTIFUL Exposition

Mechanics Building, Boston
April 15 to 29, 1922

Reservations Now Being Made

125,000 SQUARE FEET OF FLOOR SPACE

5 Mammoth Halls
Three Orchestras
Varied Attractions

FINEST EXPOSITION BUILDING IN THE U. S.

EVERYTHING FOR THE HOME

Electrical and Gas Appliances
Hardware, - Paints, - Food, - Flowers.
Heating Appliances, - Home Furnishings,
Building Materials
and an Actual House, Completely Furnished.

This Exposition affords an excellent opportunity for the manufacturers of heating and ventilating appliances to display their goods to the public.

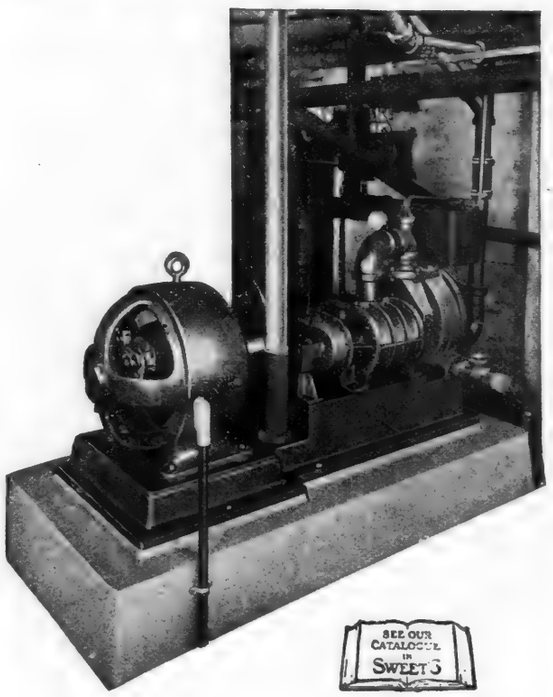
To obtain space preference, early reservation is essential

The Exposition that will appeal to all---
Instructive--Scientific--Beautiful--Entertaining

Remember the Date
April 15 to 29, 1922

Under Personal Directions of CHESTER I. CAMPBELL
Executive Office, 5 Park Square, Boston

CONNERSVILLE



The Vacuum Cleaners that Automatically Discharge All Dirt Direct to the Sewer

No buckets to empty—no germ-laden dust to handle—these features make Connersville vacuum cleaners most efficient and sanitary.

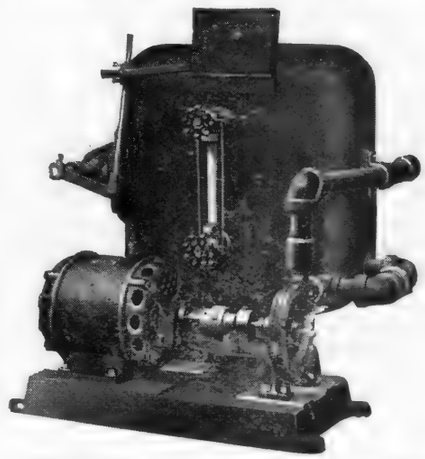
All dirt travels direct to the sewer from the cleaning tool, through the medium of the patented Connersville centrifugal separator. Tanks of all kinds are dispensed with. A small separator mounted on the same base with the pump completely separates the dirt and the air.

These cleaners are made in all sizes to meet every cleaning problem. There are Connersville representatives in the principal cities to assist you in your vacuum cleaning problems.

LANDERS, FRARY & CLARK

U. V. A. Div. Dept. C. CONNERSVILLE, IND.

WESTERN AUTOMATIC ELECTRIC CONDENSATION PUMP and RECEIVERS



RELIABLE **SIMPLE**

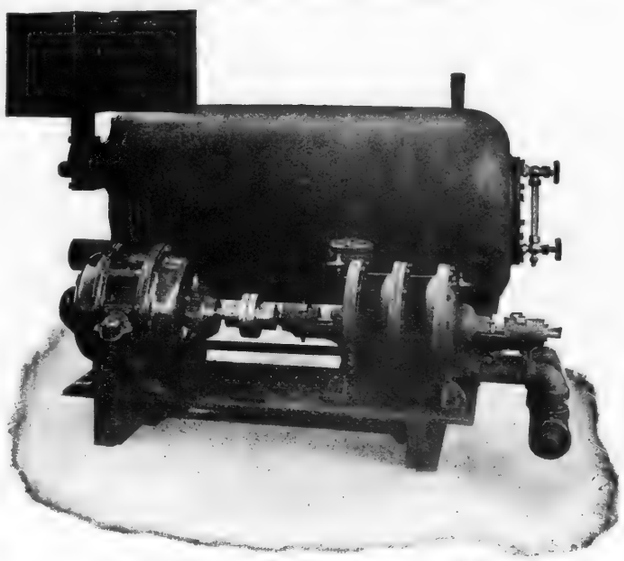
A single stage pump suitable for high or low pressure ranging from 10 lbs. to 100 lbs.

The unit is very compact, mounted on cast iron base, only two pipe connections necessary when installing. The receiver is made in two sizes, of heavy cast iron. An enclosed butt contact switch is used on all pumps.

Write for Bulletin No. 220

WESTERN ENGINEERING CO.
DAVENPORT, IOWA

YEOMANS
ELECTRICALLY OPERATED
CONDENSATION RETURN PUMPS
HORIZONTAL AND VERTICAL



SPECIAL TYPE H HIGH PRESSURE UNIT

RUGGED **RELIABLE**

Constructed to insure long life.
Superiority proven by years of experience.

Send for Bulletin C-5100

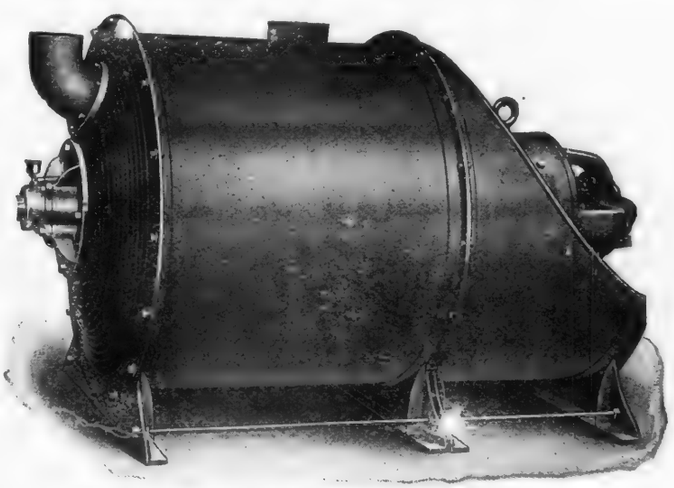
YEOMANS BROTHERS CO., 1421 Dayton St., Chicago, Ill.

Bryan Mullanphy School
St. Louis, Mo. Wm. B. Ittner, Architect

Equipped with Spencer Cleaning System when building was erected in 1915.

Neoshe School
St. Louis, Mo. R. M. Milligan, Architect

Equipped with Spencer Cleaning System when building was erected in 1918.



Horizontal slow speed Spencer Turbine vacuum cleaning exhauster. Direct motor driven, wide clearance, multi-stage type equipment.

Spencer Turbine Cleaning Systems

particularly developed for the cleaning of school buildings in a sanitary manner without spreading dust in the air, and giving the most thorough and rapid cleaning for school buildings.

Spencer systems are chosen by those who have had the most experience with vacuum cleaning apparatus in school buildings.

Over 30 schools equipped in Akron, Ohio.

17 schools equipped in St. Louis, Mo.

18 schools equipped in Cincinnati, Ohio.

13 schools equipped in Cleveland, Ohio.

19 schools equipped in Rochester, N. Y.

7 schools equipped in Springfield, Mass.

6 schools equipped in Pittsfield, Mass.

8 schools equipped in New Bedford, Mass.

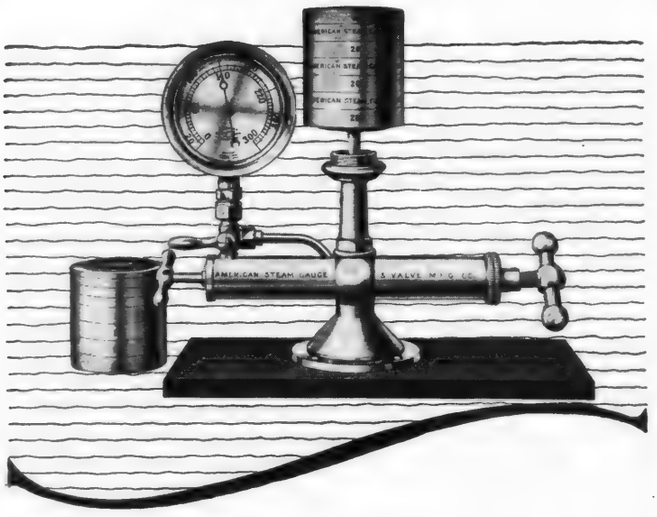
10 schools equipped in Barberton, Ohio.

10 schools equipped in Bridgeport, Conn.

9 schools equipped in Waterbury, Conn.

Send for list of references of school installations and complete data regarding the Spencer equipment.

THE SPENCER TURBINE COMPANY
Hartford, Conn.



Saves When You Use

Time is a big item of cost in testing gauges. With an American Dead-Weight Gauge Tester you can test three or four gauges in the time ordinarily required to test one with most other instruments.

This is partly because you can hold the pressure at any point as long as desired, thus making it quick and easy to take accurate comparisons of the gauge reading at any point on the dial with an

AMERICAN DEAD WEIGHT GAUGE TESTER

Another time-saving feature is in the fact that the American is the only completely self-contained tester on the market. Auxiliary chamber carries the oil for pumping into gauge tubes, with a simple action for drawing it back again after each test. No spilling or waste of oil, no waste of time, no muss or fuss.

In addition to saving minutes and, therefore, saving money every time it is used, the American also saves money in the long run, for its rugged construction means long life. It is lighter, less bulky and therefore handier to carry around than most testers.

Made in various sizes for pressures from 5 lbs. up to 1000 lbs. Other equally efficient types for higher pressures.

Our interesting Gauge Tester Circular sent on request.

AMERICAN STEAM GAUGE & VALVE MFG. CO.
Boston, Mass.

Atlanta Chicago Los Angeles New York Pittsburgh

Powell Valves

UNION COMPOSITE DISC VALVE

UNION DISC RADIATOR VALVES

Offset corner with male union

Made to suit every Requirement, with Unions and wood wheels, in Globe, Angle, Corner and offset patterns.

NOTE THE UNION BONNET CONSTRUCTION

Specify "POWELL" VALVES

Ask your dealer for Powell Valves or write us

The Wm. Powell Company
Cincinnati, Ohio

PORBECK INDUSTRIAL AIR HEATER

Adapted for heating and ventilating large buildings. No need f distributing pipes. Takes full advantage of the laws of nature in the production of warmed air and utilizes these laws in providing an even distribution of warmth and comfort throughout the largest of buildings.

Sales representatives wanted

PORBECK MFG. CO.
1000 N. Market St., St. Louis, Mo.

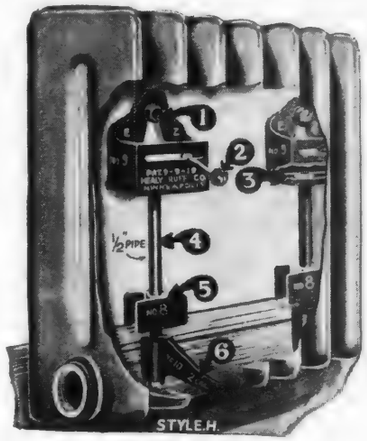
KATA-THERMOMETERS

For Sale by

SIEBE, GORMAN & CO., Ltd.

H. N. Elmer
General Agent For North America
1641 Monadock Building
CHICAGO, ILL.

SIX IMPORTANT FEATURES of *E-Z* RADIATOR HANGERS



STYLE H

1. One Bolt
2. Invisible Washer
3. Horizontal Adjustment
4. Vertical Adjustment
5. **Adjustable for Baseboard**
6. Made for Wall, and Column Radiation

STYLE R
Without Baseboard Adjustment
Reasonable Price

Made for all styles of radiation

Manufactured by
HEALY-RUFF CO.,
Minneapolis, Minn.

NONE BETTER NONE CHEAPER

AUTOMATIC ELECTRIC

Centrifugal Vacuum Pumps

ABSOLUTE GUARANTEES

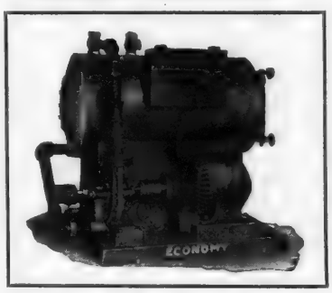


FIG 2234-C V.
SUITABLE 20 BOILER PRESSURE

Unit Number	Capacity Sq. Ft. Direct Ci. Radiation	Motor Horse Power	Cubic Ft. Air Per Minute	Water Capacity Gals. Min.
CV 1	2,500	½	1¾	6
CV 2	5,000	¾	4	10
CV 3	8,000	1	6	14
CV 4	15,000	1½	10	20
CV 5	20,000	2	15	25
CV 6	27,500	3	19	35
CV 7	40,000	5	24	60
CV 8	65,000	7½	40	100

ECONOMY PUMPING MACHINERY CO.
120-126 N. CURTIS ST. CHICAGO

STERLING SYSTEMS

Sterling Radiator Valve

PACKLESS
QUICK OPENING DURABLE
NEAT IN APPEARANCE

Made with Wheel Handle if desired
We Also Manufacture
Return Traps—Air Line Valves—Thermostatic Radiator Traps—Air Eliminators—Damper Regulators—Strainers.

STERLING ENGINEERING COMPANY
Milwaukee, Wisconsin

Vento Return Line Valve

for Vacuum and Vapor Heating Systems is a fuel-saver from the moment that it is put to work on the heating system. It never fails in its promise to make the heating system give dollar-for-dollar service for every ounce of fuel consumed.

Our latest Booklet, "The Perfect Heating System," will be mailed on request to any heating engineer

WM. S. HAINES & COMPANY
Philadelphia

Every Heating Engineer Knows the Advantages of Copper Over Iron

SPECIFY

DAHLQUIST

Copper Boilers

Let us figure on your requirements

DAHLQUIST MFG. CO.
40 West 3rd St. BOSTON, MASS.

PATTERSON

Preferred by those who recognize true merit in a water Heating System

Automatic, requiring no adjustment — and no attention whatever

Temperature is uniform under all variations of service

Time is saved by having an unlimited supply of scalding **hot water**

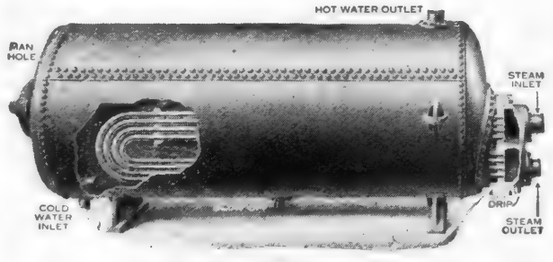
Efficient and economical. Materials and workmanship unexcelled

Reliable with nothing to get out of order and cause trouble and delay

Steam may be either exhaust, high or low pressure live steam

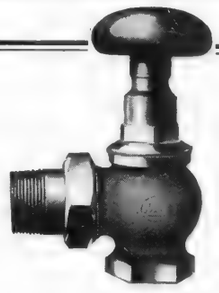
Operating cost is next to nothing no difference how long in use

Noted for supplying **Hot Water** for domestic or industrial purposes



The Patterson System of Water Heating for any Service

Patterson-Kelly Co.
23 Dey St. New York



"Genuine Detroit" Packless Radiator Valves

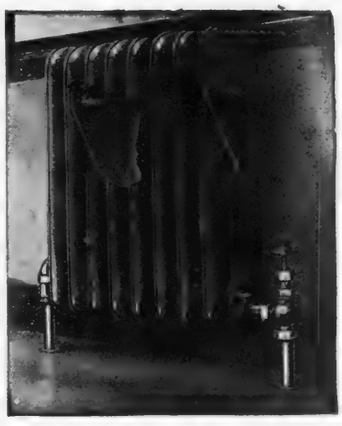
Detroit Packless Radiator Valves are the result of years of experience in the valve manufacturing field—of a careful study of valve needs—of painstaking care on the part of our engineers.

So well do these valves qualify for efficient service—for handsome design and pleasing appearance—for complete satisfaction, that leading architects, heating engineers and master builders, the country over, recommend and specify them for jobs that require the most careful consideration.

They are made for steam, vapor and vacuum heating systems—in all necessary sizes and a variety of styles. Let us send booklet giving full information.

DETROIT LUBRICATOR COMPANY.
DETROIT, U.S.A.

HARTMANN
RADIATOR BRACKETS



WHYS

LABOR SAVED

NO WALL STRIPS

NO BREAKAGE

NO DIRT

INEXPENSIVE

Send for descriptive circular and price list

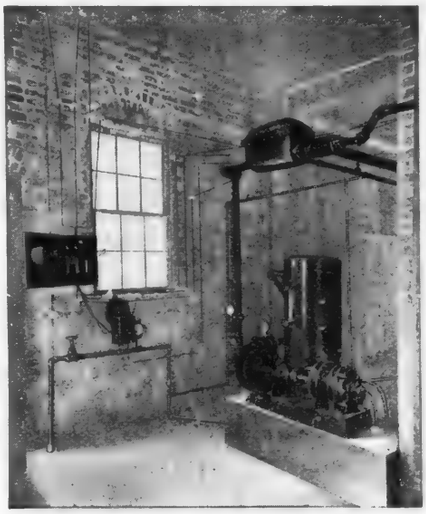
CHARLES HARTMANN CO.
SHEET METAL CONSTRUCTORS
985 Dean St., Brooklyn, N. Y.

Kalamazoo Vacuum Pump

for the heating plant.

Returns all condensation to the boiler.

The above illustration shows one of our vacuum pumps in actual working use and tests were made by experts in hydraulic engineering and electrical engineering of same.



THE PRODUCT of thirty years of engineering experience and is a FINISHED PRODUCT.

Let us have your specifications for a finished quotation.

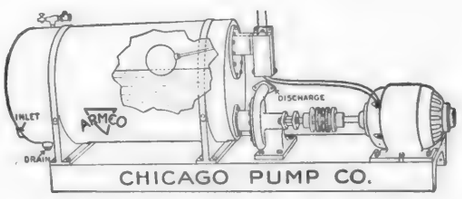
Built under the following patents:
Sept. 4, 1917, May 24, 1921. Other patents pending

MANUFACTURED BY

CLARK ENGINE & BOILER CO.

KALAMAZOO, MICHIGAN

Write for Bulletin HV-100



FAR LOWER PRICE

On

High Quality

Condensation Pump and Receiver

Standardization and Quantity production allow us to offer you the highest possible quality in this new outfit at a price hitherto impossible. Renewal parts immediately available.

Write us for full details. Ask for our new catalog and table of pumping engineering data.

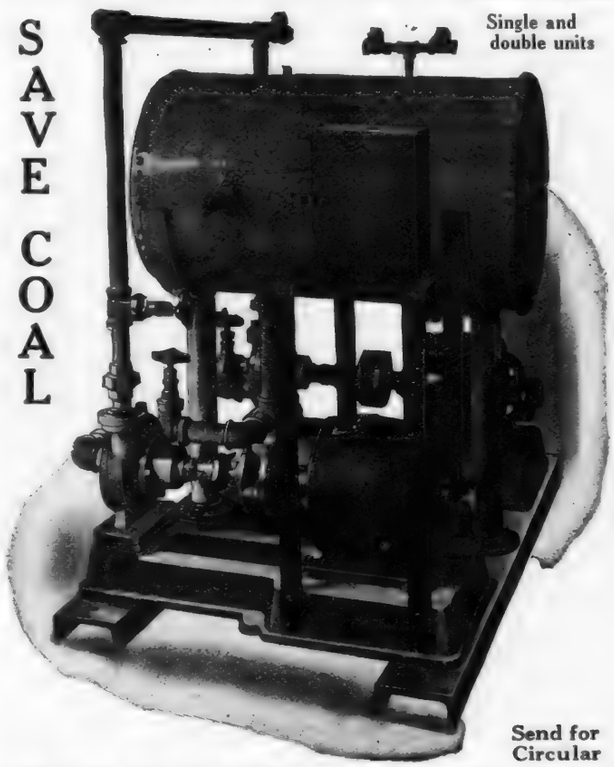
CHICAGO PUMP COMPANY
2325 Wolfram Street, CHICAGO, Illinois

THE THOMAS AUTOMATIC CONDENSATION UNITS

of all descriptions and sizes

Single and double units

SAVE COAL



Send for Circular

THOMAS PUMP WORKS, 154 Spring St., New York

How about the Saving You Make?

Government tests show that BANNER ROCK WOOL QUILT is almost twice as efficient as 85% magnesia.

Thus a saving of one ton of coal with 85% magnesia would mean practically two tons saved with Rock Wool Quilt.

Why not get in line for these extra dividends?

BANNER ROCK WOOL QUILT

100% FIREPROOF

INSULATION FOR HOT SURFACES

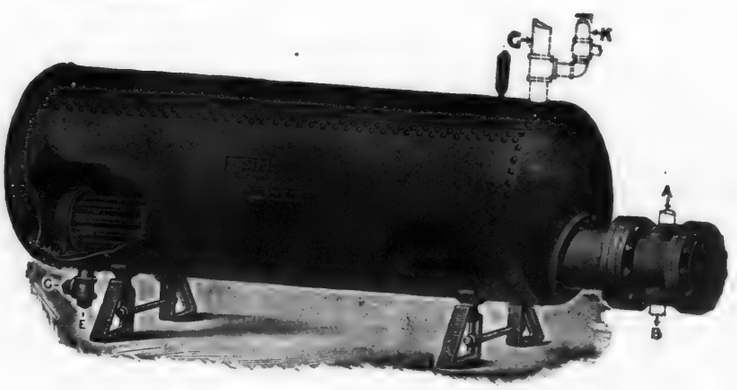
For Tanks, Tank Cars, Oil Stills, Water Stills, Heaters, Boilers of all Kinds, Boiler Breechings, Furnaces, Etc.

BANNER ROCK PRODUCTS CO., Alexandria, Ind.

Meet that Peak Demand for Hot Water

WITH A

Sims Clean E-Z Steam Tube Heater



For Hotels, Apartment Buildings, Hospitals, Y. M. C. A. Buildings, Schools, etc.

For Live or Exhaust Steam

Especially Designed for Supplying Large Quantities of Hot Water

Send for tables showing heat capacities using steam at various pressures

"We keep others in hot water"

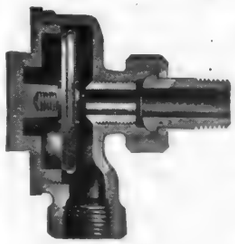
THE SIMS CO., 18th St., Erie Pa.

HEATING IDEAL EQUIPMENT

IDEAL TRAPS

Make Vapor and Vacuum Heating Systems

Efficient and Economical

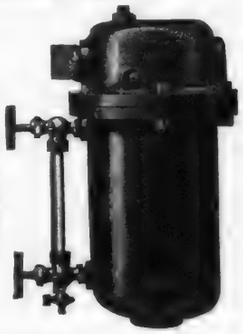


The Ideal Thermostatic Radiator Trap

Is built for long, hard service. Its rugged diaphragm withstands corrosive elements and excessive pressures. A reliable trap unaffected by sediment or scale.

The Ideal Alternate Return Trap

Assures a steady water line by returning condensation to the boiler against pressure. Freely removes all air, and makes vapor heating safe.



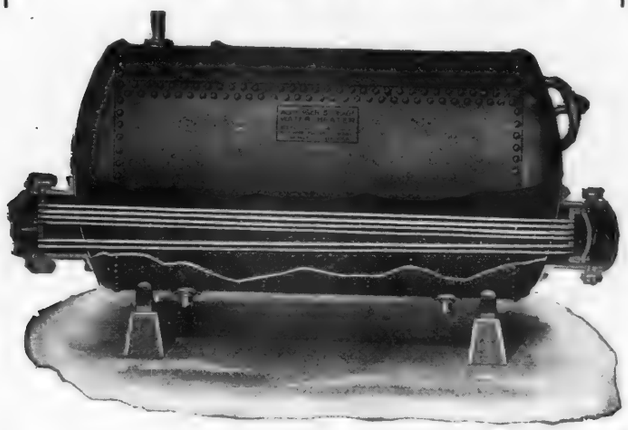
Ideal Heating Equipment Co.

1897 E. 90th St., Cleveland, Ohio.

The satisfaction of knowing that you are using an appliance of the highest quality is yours when you specify the

ALBERGER

STORAGE WATER HEATER

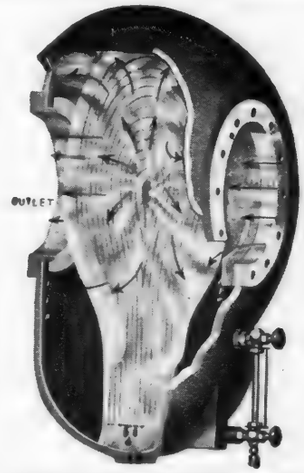


Write for Catalogue No. 3

Alberger Heater Company

BUFFALO, N. Y.

New York Offices: 1777 Woolworth Building



Wright-Austin Fig. "S" Separator

PURIFIES EXHAUST STEAM— REMOVES OIL AND GREASE

Self-cleaning—constructed of one large casting, with no joints or gaskets to leak or work loose—with wide, deeply corrugated baffle plate and great internal area, which absolutely prevents "back pressure" on the engine—the Wright-Austin Figure "S" Horizontal Self Cleaning Oil Separator is generally regarded by engineers everywhere as the most efficient device for purification of exhaust steam.

The Figure "S" is guaranteed to thoroughly eliminate oil, grease and impurities from exhaust steam to such an extent that the steam, when condensed is entirely suitable for boiler use.

The installation of the Figure "S" is as simple and easy as connecting a valve or fitting in the exhaust line. And there are no renewals—no time or shut downs for cleaning—not a dollar of further expense or upkeep or maintenance of any kind.

Let us send you the Wright-Austin catalog. It completely describes our steam savers—which will increase the efficiency of your plant.

WRIGHT-AUSTIN CO.

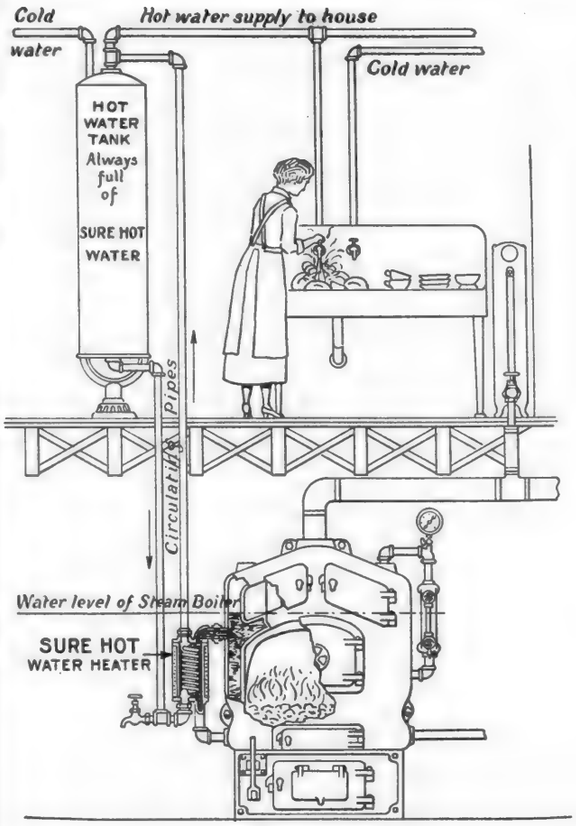
DETROIT, MICHIGAN

Branch Offices---New York, Chicago, Boston
Export Office---30 Church St., New York City

REPRESENTATIVES EVERYWHERE

(44)

WRIGHT W-A Standard STEAM USERS SINCE '94 AUSTIN



The WHITLOCK Sure Hot Water Heater

A perfected economy in residence hot water heating.

Boiling water from the steam boiler furnishes the heating agent. Thus the water can never overheat but is delivered instantly in any quantity at about 150°.

Moderately priced according to sizes at $18.50 to $55.50, crated f. o. b. Hartford.

Descriptive Bulletins on request

The Whitlock Coil Pipe Company

New York HARTFORD Chicago
Philadelphia Boston

"Whitlock Heaters have Everlasting Copper Tubes"

Better Than Ratchet Handle

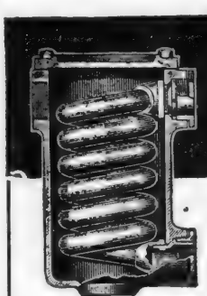
THIS "Toledo" Power Drive for geared hand threaders and cutters is connected or disconnected just the same and just as easily as ratchet handle, yet it operates pipe tools five times faster than by hand. Write us for circular and catalog "F".

The Toledo Pipe Threading Machine Co.

TOLEDO, OHIO

New York Office:
50 Church St., New York City

TOLEDO DRIVE
PORTABLE POWER



HOT WATER AT LOWEST POSSIBLE COST

Sectional View

ELIMINATES FIRE POT COILS

Connects to *outside* of any steam or vapor heating boiler. Generates *constant supply* uniformly hot water.

Endorsed and sold by the following boiler manufacturers:

American Radiator Co.
Richardson & Boynton Co.
Richmond Radiator Co.
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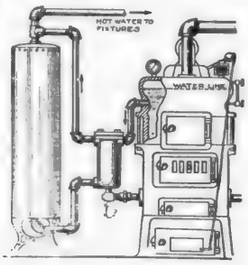
Pierce, Butler & Pierce Mfg. Co.
United States Radiator Corp.
International Heater Co.
Boynton Furnace Co.
The Wm. H. Page Boiler Co.
Gurney Heater Mfg. Co.
Thatcher Furnace Co.
Abendroth Bros.

Also by Plumbing and Heating Jobbers Everywhere

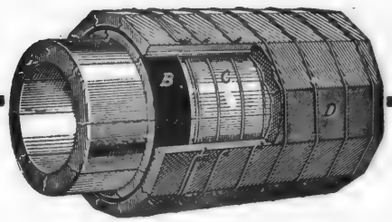


Heater Installed between Boiler and Tank

Order Excelso Heaters with your other heating equipment. Or write for details of attractive proposition.

EXCELSO

Excelso Specialty Works, 117 Clinton St., Buffalo, N.Y.



A—Inner Shell, 2 inches thick.
B—Asphaltum Packing.
C—Dead Air Space.
D—Outer Shell, 1 inch thick.

Cover Your Steam Pipes with

Wyckoff's
Improved
Cypress Covering

Not affected by wet and dry conditions common to steam-pipe trenches. Will not rot. Absolutely water and steam tight. Each shell is wound with extra-heavy steel wire. Coated all over with the best known preservative—**Montezuma Asphalt.**

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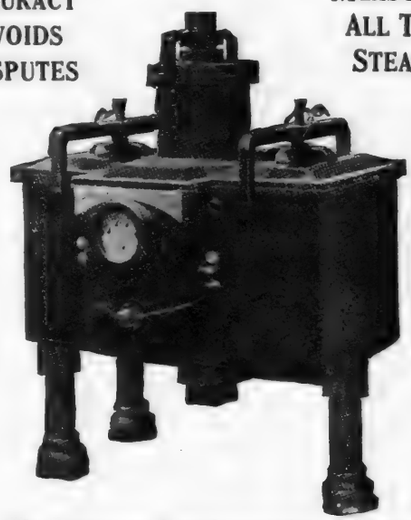
A. WYCKOFF & SON CO.
ELMIRA, N. Y.

ACCURACY AVOIDS DISPUTES

MEASURES ALL THE STEAM



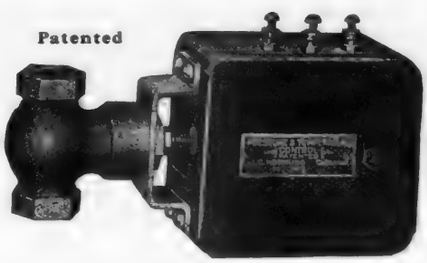
The Mason Condensation Meter

Bucket type, measuring the quantity of condensed steam by actual displacement, for every condensate measuring service.

Especially adapted to Vacuum Systems

PLANT ENGINEERING AND EQUIPMENT CO. Inc.
192 Broadway New York, N. Y.
Chicago Boston Philadelphia Cleveland San Francisco

Patented



The HORNUNG Magnetic Valve

This is the little valve used as a pilot on all sizes of HORNUNG PRESSURE and TEMPERATURE CONTROL VALVES. It has many other uses.

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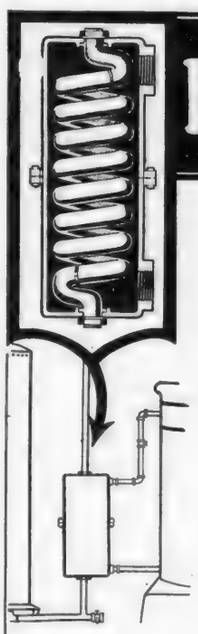
CENTRAL HEAT APPLIANCES
J. C. HORNUNG
343 South Dearborn St. Chicago



PLENTY OF HOT WATER NO EXTRA EXPENSE

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An unusual opportunity for live dealers. Order now and be prepared for the demand being created. We furnish cooperation and practical sale helps to give you full benefit of our national advertising. Write for full details.

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"Makers of Heaters that Heat"
Cleveland, Ohio

The **Hotstream** INDIRECT WATER HEATER

We also make a complete line of Gas and Kerosene Water Heaters.

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Air Compressors.
Nash Engineering Co., So. Norwalk, Conn.
Plant Engineering & Equipment Co., New York.

Air Conditioning Apparatus.
American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corporation, Philadelphia, Pa.
Carrier Air Conditioning Co., Buffalo. N. Y.
Carrier Engineering Corporation, New York.
W. L. Fleisher Co., New York, N. Y.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Spray Engineering Co., Boston, Mass.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
L. J. Wing Mfg. Co., New York.

Air Coolers.
Alberger Heater Co., Buffalo, N. Y.
Badger & Sons Co., E. B., Boston Mass.
Griscom-Russell Co., New York.

Air Cooling and Drying Systems.
Atmospheric Conditioning Corp., Phila., Pa.
Buffalo Forge Co., Buffalo., N. Y.
Carrier Engineering Corporation, New York.
Clarage Fan Co., Kalamazoo, Mich.
W. L. Fleisher Co., New York, N. Y.
Garden City Fan Co., Chicago, Ill.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago. Ill.
Spray Engineering Co., Boston, Mass.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
L. J. Wing Mfg. Co., New York.

Air Eliminators.
Jas. P. Marsh & Co., Chicago, Ill.

Air Separators
Griscom-Russell Co., New York.
Hoffman Specialty Co., New York.

Air Washers.
American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corp., Phila., Pa.
Buffalo Forge Co., Buffalo. N. Y.
Carrier Air Conditioning Co., Buffalo, N. Y.
Carrier Engineering Corporation, New York.
W. L. Fleisher Co., New York, N. Y.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
Mellish Hayward Co., Chicago. Ill.
New York Blower Co., Chicago, Ill.
Spray Engineering Co., Boston, Mass.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Blowers.
FAN.
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Autovent Fan & Blower Co., Chicago, Ill.
Bayley Mfg. Co., Milwaukee, Wis.
Buckeye Blower Co., Columbus, Ohio.
Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Garden City Fan Co., Chicago, Ill.
Hackney Mfg. Co., St. Paul, Minn.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago. Ill.
Porbeck Mfg. Co., St. Louis, Mo.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
L. J. Wing Mfg. Co., New York.
PRESSURE.
American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Buffalo, Forge Co., Buffalo, N. Y.
Connersville Blower Co., Connersville, Ind.
Garden City Fan Co., Chicago, Ill.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
L. J. Wing Mfg. Co., New York.
ROTARY.
Connersville Blower Co., Connersville, Ind.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
L. J. Wing Mfg. Co., New York.
TURBINE.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Plant Eng'g& Equipment Co., New York.
L. J. Wing Mfg. Co., New York.

Boiler Breechings.
Hartmann Co., Charles, Brooklyn, N. Y.
Johns-Manville, Inc., New York.

Boiler Cement.
Shur-Tite Mfg. Co., Cleveland, O.

Boilers.
COPPER.
Dahlquist Mfg. Co., Boston, Mass.
HEATING.
American Radiator Co., Chicago, Ill.
Clark Engine & Boiler Co., Kalamazoo, Mich.
Gorton & Lidgerwood Co., New York.
Gurney Heater Mfg. Co., Boston, Mass.
Illinois Malleable Iron Co., Chicago, Ill.
International Heater Co. Utica, N. Y.
Kewanee Boiler Co., Kewanee, Ill.
Page Boiler Co., Wm. H., New York.
Standard Heater Co., Williamsport. Pa.
Titusville Iron Works Co., Titusvile, Pa.
Utica Heater Co., Utica, N. Y.
DOWN-DRAFT.
American Radiator Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Ill.
Kewanee Boiler Co., Kewanee, Ill.
Page Boiler Co., Wm. H., New York.

Calorimeters.
Sarco Co., New York.
Schaefer & Budenberg Mfg. Co., Brooklyn, N. Y.

Coils, Pipe.
Simmons Co., John, New York.
AIR.
New York Blower Co., Chicago, Ill.

Coolers.
OIL.
Griscom-Russell Co., New York.

Condensers.
Alberger Heater Co., Buffalo, New York.
Alberger Pump & Condenser Co., New York.
American Radiator Co., Chicago, Ill.
American Steam Pump Co., Battle Creek, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Converters, Hot Water.
Patterson-Kelley Co., New York.
Whitlock Coil Pipe Co., Hartford, Conn.

Covering, Pipe.
American District Steam Co., No. Tonawanda, N. Y.
Century Conduit Co., Pittsburgh, Pa.
Hornung, J. C., Chicago, Ill.
Johns-Manville, Inc., New York.
National Asbestos Mfg. Co., Jersey City, N. J.
Ric-Wil Co., Cleveland, O.
Wyckoff & Son Co., A., Elmira, N. Y.

Dampers, Duct.
Sixth City Sheet Metal Works, Co., Cleveland,O
American Blower Co., Detroit, Mich.

Dehumidifying Apparatus.
Atmospheric Conditioning Corp., Phila., Pa.
Carrier Air Conditioning Co., Buffalo, N. Y.
Carrier Engineering Corporation, New York.
W. L. Fleisher Co., New York, N. Y.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Distillers.
WATER.
Griscom-Russell Co., New York.

Drying Systems.
(See Air Cooling and Drying Systems.)

Dust Collecting Systems.
American Blower Co., Detroit, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Dust Collectors.
Atmospheric Conditioning Corp., Phila., Pa.
Clarage Fan Co., Kalamazoo, Mich.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F. Hyde Park, Boston, Mass.

Dust Determinators.
Atmospheric Conditioning Corp., Phila., Pa.

Economizers, Fuel.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Equalizing Loops.
Hoffman Specialty Co., New York.

Exhaust Systems.
Hartmann Co., Charles, Brooklyn, N. Y.

Engines.
STEAM, AUTOMATIC.
American Blower Co., Detroit, Mich.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F. Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
STEAM, HIGH SPEED.
American Blower Co., Detroit, Mich.
Clarage Fan Co., Kalamazoo, Mich.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Evaporators.
BOILER FEED MAKE-UP.
Griscom-Russell Co., New York.

Exhaust Heads.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Simmons, Co., John, New York.
Surtevant Co., B. F., Hyde Park, Boston, Mass.
Wright-Austin Co., Detroit, Mich.

Expansion Joints.
Alberger Heater Co., Buffalo, N. Y.
Alberger Pump & Condenser Co., New York.
American District Steam Co., No. Tonawanda, N. Y.
Century Conduit Co., Pittsburgh, Pa.
Crane Co., Chicago, Ill.
Griscom-Russell Co., New York.
Hornung, J. C., Chicago, Ill.
Illinois Engineering Co., Chicago, Ill.
Johns-Manville, Inc., New York.
Ric-Wil Co., Cleveland, O.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Webster & Co., Warren, Camden, N. J.

Fans, Exhaust.
American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Bayley Mfg. Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Garden City Fan Co., Chicago, Ill.
Hackney Mfg. Co., St. Paul, Minn.
Hersh Bros. Co., Allentown, Pa.
Ilg Electric Ventilating Co., Chicago, Ill.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
L. J. Wing Mfg. Co., New York.

Filters.
AERATING.
Griscom-Russell Co., New York.
Johns-Manville, Inc., New York.
FEED-WATER.
Griscom-Russell Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.

Fittings, Flanged
American District Steam Co., No. Tonawanda, N. Y.
Crane Co., Chicago, Ill.
Simmons Co., John, New York.

Flanges.
American District Steam Co., No. Tonawanda, N. Y.
Crane Co., Chicago, Ill.
Jenkins Bros., N. Y.

Gas Burners.
Cleveland Gas Burner & Appliance Co., Cleveland, Ohio.

Gaskets, Metallic.
Johns-Manville, Inc., New York.
Sarco Co., New York.

Gauge Boards.
Bishop & Babcock Co., Cleveland, O.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
McAlear Mfg. Co., Chicago. Ill.
Jas. P. Marsh & Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Co., Rochester, N. Y.
Webster & Co., Warren, Camden, N. J.

Gauges.
DRAFT.
American Steam gauge & Valve Mfg. Co., Boston, Mass.
Jas. P. Marsh & Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
HYDRAULIC.
Jas. P. Marsh & Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
OUNCE GRADUATED.
Jas. P. Marsh & Co., Chicago, Ill.
PRESSURE.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
American Dist. Steam Co., North Tonawanda, N. Y.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Webster & Co., Warren, Camden, N. J.
VACUUM.
Bishop & Babcock Co., Cleveland, O.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Taylor Instrument Co., Rochester, N. Y.
Webster & Co., Warren, Camden, N. J.
WATER.
American Steam Gauge & Valve Mfg. Co., Boston, Mass.
American District Steam Co., No. Tonawanda, N. Y.
Detroit Lubricator Co., Detroit, Mich.
Jenkins Bros., New York.

Generating Sets.
American Blower Co., Detroit, Mich.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Generator Cooling Systems.
Atmospheric Conditioning Corp., Phila., Pa.

Governors, Pump.
Atlas Valve Co., Newark. N. J.
Davis Regulator Co., G. M., Chicago, Ill.
Fulton Co., Knoxville, Tenn.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Mason Regulator Co., Boston, Mass.
Plant Engineering & Equipment Co., New York.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
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Cross Section of the Super-Smokeless Boiler

Arrows Indicate Current of Fresh Air to the Flame

Save Coal With This Boiler

An Imperial Super-Smokeless Boiler, installed in the Imperial Theatre in Philadelphia, saved over 63% on the previous year's coal bill despite much colder weather.

This is typical of the efficiency of these boilers with their scientific design. The Bunsen Burner Idea of admitting more air (oxygen) to the flame, gives an intense heat which burns up smoke and all combustible gases, assuring remarkable steam capacity from the cheaper grades of soft coal.

Investigate this fuel-saving, smokeless boiler. Complete description and list of many installations sent upon request.

UTICA HEATER COMPANY
UTICA, New York

218-220 West Kinzie Street, Chicago, Illinois

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Imperial Super-Smokeless Boilers

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American Radiator Co., Chicago, Ill.
Dahlquist Mfg. Co., Boston, Mass.
Excelso Specialty Works, Buffalo, N. Y.
Griscom-Russell Co., New York.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Sims Co., Erie, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.

FEED WATER (Closed).

Alberger Heater Co., Buffalo, N. Y.
Alberger Pump & Condenser Co., New York.
Griscom-Russell Co., New York.
McAlear Mfg. Co., Chicago, Ill.
Patterson-Kelley Co., New York.
Ross Heater & Mfg. Co., Buffalo, N. Y.
Simmons Co., John, New York.
Sims, Co., Erie, Pa.
Whitlock Coil Pipe Co., Hartford, Conn.

FEED WATER (Open).

Griscom-Russell Co., New York.
Sims Co., Erie, Pa.
Webster & Co., Warren, Camden, N. J.

FUEL-OIL.

Griscom-Russell Co., New York.

PIPE COIL (AIR).

American Blower Co., Detroit, Mich.
Bayley Mfg. Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Clarage Fan Co., Kalamazoo, Mich.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Heating Systems.

UNIT BLAST.

American Blower Co., Detroit, Mich.
Autovent Fan & Blower Co., Chicago, Ill.
Ilg Electric Ventilating Co., Chicago, Ill.
Skinner Bros. Mfg. Co., St. Louis, Mo.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

UNIT AIR.

Moline Heat, Moline, Ill.

GRAVITY AND FORCED CIRCULATION, WATER.

Alberger Heater Co., Buffalo, N. Y.

VACUUM.

Bishop & Babcock Co., Cleveland, O.
Dunham Co., C. A., Chicago, Ill.
Ideal Heating Equipment Co., Cleveland, O.
Illinois Engineering Co., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Jas. P. Marsh & Co., Chicago, Ill.
Sarco Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Webster & Co., Warren, Camden, N. J.

VAPOR.

American District Steam Co., No. Tonawanda, N. Y.
Dunham Co., C. A. Chicago, Ill.
Haines & Co., Wm. S., Philadelphia, Pa.
Ideal Heating Equipment Co., Cleveland, O.
Illinois Engineering Co., Chicago, Ill.
Illinois Malleable Iron Co., Chicago, Il.
Marsh & Co., Jas. P., Chicago, Ill.
McAlear Mfg. Co., Chicago, Ill.
Moline Heat, Moline, Ill.
Mouat-Squires Co., Cleveland O.
Sarco, Co., New York.
Sterling Engineering Co., Milwaukee, Wis.
Trane Co., La Crosse, Wis.
Webster & Co., Warren, Camden, N. J.

Humidifiers.

American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corp., Phila., Pa.
Carrier Air Conditioning Co., Buffalo, N. Y.
Carrier Engineering Corporation, New York.
Douglass & Co., Thos. J., Chicago, Ill.
W. L. Fleisher Co., New York, N. Y.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago Ill.
Spray Engineering Co., Boston, Mass.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Humidity Control.

Atlas Valve Co., Newark, N. J.
American Blower Co., Detroit, Mich.
Atmospheric Conditioning Corp., Phila., Pa.
Carrier Engineering Corporation, New York.
W. L. Fleisher Co., New York, N. Y.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

Hydrometers.

Jas. P. Marsh & Co., Chicago, Ill.
Taylor Instrument Cos., Richester, N. Y.

Instruments.

ELECTRIC MEASURING.

Taylor Instrument Cos., Rochester, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

INDICATING AND RECORDING.

Johns-Manville, Inc., New York.
Jas. P. Marsh & Co., Chicago, Ill.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.
Sarco Co., New York.
Sixth City Sheet Metal Works Co., Cleveland, O.
Taylor Instrument Cos., Rochester, N. Y.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Insulating Materials.

American District Steam Co., No. Tonawanda, N. Y.
Banner Rock Products Co., Alexandria, Ind.
Century Conduit Co., Pittsburgh, Pa.
Hornung, J. C., Chicago, Ill.
Johns-Manville, Inc., New York.
National Asbestos Mfg. Co., Jersey City, N. J.
Ric-Wil Co., Cleveland, O.
Wyckoff & Sons, A., Elmira, N. Y.

Manometers.

Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

Mechanical Draft Apparatus.

American Blower Co., Detroit, Mich.
Clarage Fan Co., Kalamazoo, Mich.
Massachusetts Blower Co., Watertown, Mass.
New York Blower Co., Chicago, Ill.
Plant Engineering & Equipment Co., New York.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
L. J. Wing Mfg. Co., New York.

Meters.

CONDENSATION.

American Dist. Steam Co., No. Tonawanda,
Central Station Steam Co., Detroit, Mich.
Hornung, J. C., Chicago, Ill.
Plant Engineering & Equipment Co., New York.

FEED WATER.

Simmons Co., John, 110 Center St., New York.

(FEED WATER (Wier Type).

Webster & Co., Warren, Camden, N. J.

PITOT TUBE.

American Blower Co., Detroit, Mich.
Schaeffer & Budenberg Mfg. Co., Brooklyn, N. Y.

STEAM.

American District Steam Co., No. Tonawanda, N. Y.

Motors.

ELECTRIC.

Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Ozonators.

Ozone Pure-Airifier Co., Chicago, Ill.

Paint, for Heated Surfaces.

Ric-Wil Co., Cleveland, O.

Pipe.

SOIL.

Simmons Co., John, 110 Center St., New York.

STEEL.

Simmons Co., John, 110 Center St., New York.

WROUGHT IRON.

Simmons Co., John, 110 Center St., New York.

WOOD.

Wyckoff & Sons Co., A., Elmira, N. Y.

Pipe Bending.

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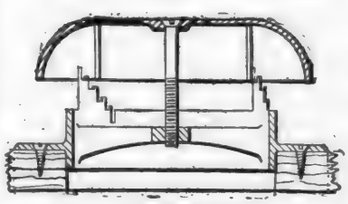

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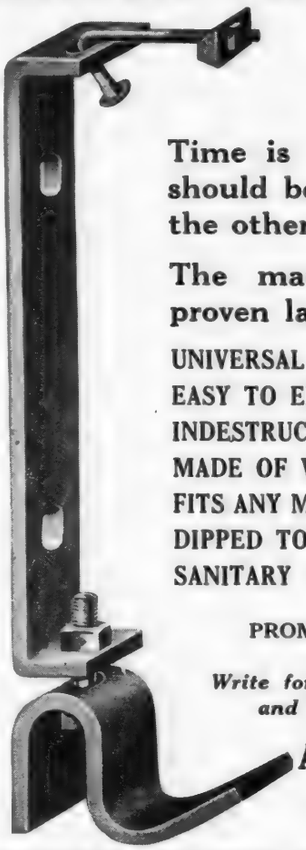

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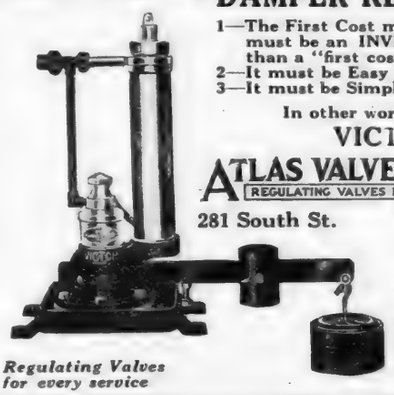

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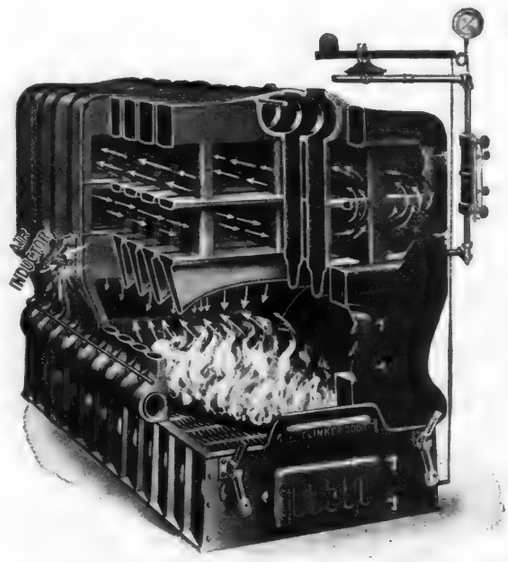

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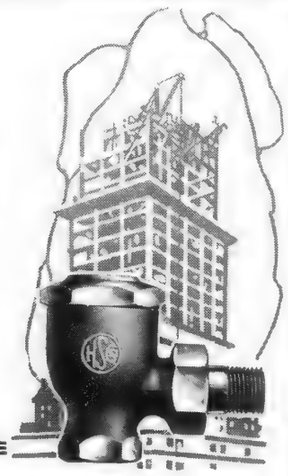

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